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MODULE 1

UNIT 1 NATURE OF SCIENCE & SCIENTIFIC INQUIRY

CONTENTS

1.0 INTRODUCTION

The nature of science and scientific inquiry has been partly dealt with in the units 3 & 4 of SED 701 (Foundations of Science Education). The continuation in this unit will further expose you to study what makes science different from other areas of knowledge.

2.0OBJECTIVES

At the end of this unit, you should be able to:

- differentiate science from non-science on the basis of:
  i. Concepts
  ii. Structure by which concepts are related
  iii. Ways by which statement are tested against experience
- list some common misconceptions

- derive the implications for science teaching
- describe how science progresses.

3.0 MAIN CONTENT

3.1 Nature of Science and Scientific Inquiry (Abridge)

Paul Hirst in attempting to distinguish between the various forms of knowledge postulated four distinguishing features claiming that every forms of knowledge possesses:

- **Characteristic basic concepts**

Every form of knowledge has some characteristics basic concepts, example of valency in Chemistry, flux density in Physics, revolution in history etc. Some concepts are shared by different disciplines, example, the atom is a basic concept in physics, chemistry and biology.

- **Characteristic structures by which concepts are related**

The periodic table is a structure and the activity series is another one. As the knowledge of science expands its structures becomes more and more mathematically complex.

- **Characteristic ways by which statements are tested against experience**

In the sciences, the test takes the form of observing, if some particular experimental results or observations at particular instances of a generalization, the results of such tests in sciences are usually very sharp. Let us not become ignorant of the practical aspect of experimental results (experiment errors even in the equations that has been derived).

It may be wrong to claim that, only the sciences are capable of making statements which can be tested against experience.

Rather it is correct to claim, the tests to which the statements of science are put which are usually more clear-cut than those of other forms of knowledge; all forms of knowledge have characteristic tests to which ideas claiming to be new knowledge are subjected before they are accepted. It is worth mentioning than in some areas such as art, these tests are entirely subjective, as well as depending on personal response and being difficult to rationalize, the results of such tests are not likely to be supported by the consensus of opinion usually in science.

- **Characteristic techniques and skills for exploring experience**

In the past, much of school practical work was concerned with instructions in these techniques, in chemistry for example, volumetric analysis and the Wheatstone bridge in Physics. We may ask, do pupils actually use these skills in exploration? They might have been getting excellent results during the practical lessons in the classroom. But they were given little opportunity for exploration. The modern practice is to allow pupils develop skills for exploration.

The Nuffield Project and Science between 5 – 13 years are examples of the programmes which gives pupils the opportunities to develop skills for exploration.

These four characteristic are of great importance to science teachers.

For every topic he teaches, he should relate to at least one of the four characteristics. The understanding of these characteristics will help the teacher. Characteristics 2 (the structure of science) for example is abstract, and so should be introduced only at later years (13 above). Our science courses should be designed in such a way that, at the end of the 6th year of secondary school our pupils should have experience of all the four characteristics of the form of knowledge which he is studying. The most illuminating way in which we can explore the methods of science further is, through an examination of the relationship between theory and observation.

> In the introduction and guide to the Nuffield Chemistry Course, the authors stated:
>
> We want pupils to learn to distinguish between observed phenomena and explanation put forward by the creative thinking of the human mind.
>
> Pupils must learn to see the interplay between observed fact and explanation…and to appreciate how science develops through this interplay.

Popper (1985) used what distinguishes science from other forms of knowledge to define science as the only subject which could provide statement that could be tested against observation. This definition serves as a solution to the problem of demarcation between science and other forms of knowledge.

SELF ASSESSMENT EXERCISE 1

How will the four postulates of Paul Hirst be of useful to you as a science teacher?

3.2 Observation and Theory (Some Misconceptions)

To understand more clearly the relationship between observation and theory let us consider two examples of some kinds of logic given below

Logic 'A	Logic 'B
(i). The exterior angle of triangle is equal to the sum of the two interior opposite angles.	**All insects have six legs**
(ii). The angle on a straight line is two right angles. (we deduce that)	**All beetles are insects**
(iii). The sum of the angles of a triangle is equal to two right angles.	**All beetles have six legs.**

Considering logic A, statement (iii) which we have proved to hold. It is always true, it will always hold. Suppose you tell a mathematician that you have proved by drawing different triangles statement (iii) to be wrong i.e. the sum of the angles of a triangle is not always two right angles. He will not agree with you but rather argue that your diagrams (triangles) are faulty somehow. The only way you can show statement (iii) to be wrong is by disproving either of the first two statements.

Now look at logic 'B'. If by some observations you found out that some beetles have four legs, you will not be disproving statement (iii) but rather showing faults in the initial statement (statements (i) and (ii)). Because of the precision in logic, it's applications in science could be accepted and it has been applied successfully in many areas, in all the sciences.

Logic is all right for relating one part of a theory to another but when logic is applied to link an observation with a theory, trouble arises in some cases (faults). Let us turn to Logic B. If the initial statements are true ((i) &(ii)), the conclusion (iii) is incontrovertible and any observation of creatures we should like to classify as four legged beetles would cast doubts on the initial postulates ((i) & (ii)) rather than the argument (iii).

It is fairly easy for us to see that it is impossible to deduce (in the sense in which we have been using the word) a generalization from a number of observations. It would be an attempt to make a statement covering an infinite number of instances from a finite (few) number of instances; deduction can only apply to the relationship between generalizations and definitions (or other axioms).

3.3 Some Common Misconceptions

One of the ways in which a science is different from an art or social science lies in the nature of its theories: they are much more firmly established.

The misconception here is that scientists accept without questioning all aspects covered by a theory. It looks delicate to them, like something that could not be tempered with.

Another misconception is held by students. Here they are made to learn (cover) a large area of scientific concepts, principles etc there seems to be no or less time for other scientific activities such as experimentation, exploring etc; which could lead students to discovered things by themselves. This practice makes students to think that science does not provide opportunity for the expression of differences of opinion, for imagination, and for creative work. They feel that there is no scope for personal contribution, that knowledge is embodied in the natural world waiting to be discovered and, once discovered, must be accepted without any question. The scientist is seen to be entirely objective: he makes his observations and deduces generalizations from them.

Students also come to believe without thinking about experimental results, the prove that a theory is right, and they accept easily things that they cannot see such as the existence of the molecules electrons, etc.

Relating the nature of science to science teaching

Nature of science	Science teaching
• **As a body of knowledge**	**Develop learning strategies that will lead to the acquisition of cognitive skills.**
• **As human involving processes of inquiry**	**Develop learning strategies that will foster the spirit of enquiry, like observation, testing etc.**
• **Conceiving science as a human activity carried out by scientists**	**Develop learning strategies that will stimulate creative ability, critical thinking, curiosity and open-mindedness of the learners.**
• **Science as a social institution and an important agent to social change**	**Provide group activities for children. Draw examples from other areas to support teaching. Encourage students to participate in science organizations.**

SELF ASSESSMENT EXERCISE 2

Describe the most common misconceptions held by students about science subjects.

3.4 The implication for Science Teaching

- This paper suggests the adaptation of the Nuffield Projects in the teaching of science in schools. However, it is advised that the approach should be adopted with caution.

- The misconception that science is the "truth" should be ruled out of our minds (teachers and students). Popper expresses the failure to apply the rules of logic to science with this analogy:

Science does not rest on solid bedrock. The bold Structure of its theories rises as if it were above swamp.

It is like a building created on piles. The piles are driven down from above into the swamp, but not down to any natural base and if we stop driving the piles deeper it is not because we have reached firm ground.

We simply stop when we are satisfied that they are firm enough to carry the structure at least for the time being.

The understanding of the uncertainty and of the dependence of science on human imagination and reason help to reduce the misconception that science is the fundamental truth.

Finally, science teachers should shift from the traditional way of teaching scientific facts, principles and rules to the teaching of science process skills and of encouraging students to explore things (their environment).

SELF ASSESSMENT EXERCISE 3

How will you explain science process skill to your students?

3.5 How Science Progresses

Science progresses through the process of induction and also by the process of conjecture and refutation. Kuhn puts forward that theory of science change because scientists cease to adhere to one theory and adopt another, a process he considered to be political in nature. Kuhn argues that in much of science, in what he calls 'normal science', scientists are not concern with the fundamental questioning of the theory but rather in solving the problems generated by the theory, the extend (area) in which it can be applied or in refining it. This is the ability of the scientists to use the theory (normal science). Before a theory is put into question the following factors must be considered

- The practical importance of the theory
- How long it has existed
- The fundamental of the theory

When a theory is about to be discarded efforts are made by a large number of sciences to weaken the old theory in order for the new theory to gain acceptance (extra-ordinary science). Kuhn sees the progress of science as succession of revolutions in which a variety of factors plays a part rather than a logical progression of conjectures and refutations.

Lakatos combined the ideas of Kuhn and Popper and came to conclude that the processes in which science progresses are logical. However, he considered the importance played by convention as attached to scientific research.

Lakatos seems to agree more with Kuhn. To him there is no firmly established or widely held theory of how science progresses but the

process; Problem - Hypothesis- Experiment - Result needs to be applied with caution.

IMPORTANT: Scientists should agree more with Kuhn when he said, it is the experimenter who is at test and not the theory.

Scientists should concern themselves more with discussing the results of experiments (Scientific community) suggesting ways of reducing experimental error rather than discussing theories.

SELF ASSESSMENT EXERCISE 4

What is Kuhn's view of normal science?

4.0 CONCLUSION

Having understood all the four characteristics of knowledge, the modern science teacher is now left with the option of choosing one or combining a number of them and relate each of the topic he would teach to it, and by the time a student has completed six years of secondary education he would have experience of all the four characteristics of the subject he learnt.

We would emphasize that in science teaching, students should be given enough chance to explore, and the acquisition of the science process skills should not be left out as was the case in the olden days.

5.0 SUMMARY

So far, you have been able to learned how to distinguish between various forms of knowledge using the features postulated by Paul Hirst and some common misconceptions about science as well as its implications for science teaching. Kuhn, Lakatos and Popper ideas about science were used in explaining how science progresses. You will learn in the next unit: development of science education in Nigeria before and since independence.

6.0 TUTOR-MARKED ASSIGNMENT

1. List the four features postulated by Paul Hirst in distinguishing various forms of knowledge.
2. In a tabular form, briefly discuss how you will relate the nature of science to science teaching.

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UNIT 2 SCIENCE EDUCATION IN NIGERIA I

CONTENTS

1.0 INTRODUCTION

This unit is a continuation of Units 21 and 22 in SED 701 (Foundations of Science Education). The unit centre on the development of science education which is concerned with understanding the learning and teaching of science. The main focus of the unit is the development of science education in Nigeria before and since independence.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain development of science education in Nigeria before and since independence
- mention the roles played by Federal Government of Nigeria in science education development since independence to date
- list the curriculum agents involved in making teaching of science possible in our schools.

3.0 MAIN CONTENT

3.1 Science Education in Nigeria before Independence

The history of modern science teaching in Nigeria is very recent. When western education was introduced to Nigeria in 1843 science was not part of the school curriculum. An example was on literary education. Science education in Nigeria started from the primary school unlike what obtained in most western countries where science teaching grew

from the Universities to higher schools. The foundations for modern science education in Nigeria were laid between 1861 and 1897 when rudiments of science were developing into full science course (Aliyu 1984).

By 1926, Nature Study had become a popular subject in some Primary Schools and Teacher Training Colleges. Elementary Science was taught at the first Government Teachers' College in the North. Later a Teacher Training College which specialized in teaching Rural Science was established in Minna. The depth and coverage of the subject were shallow because of scarcity of teachers and resources.

Post Secondary institutions were opened for the study of science due to pressure by some nationalists who studied abroad. The first of its kind was Yaba Higher College established in 1934. It was aimed at provision of intermediate manpower in Medicine, Agriculture, Survey, Engineering and Teachers to teach basis science subjects in secondary schools.

Most Nigerian secondary schools started offering General Science as a single subject. It started losing its popularity when students who successfully completed the course could not be accepted into high school to study Chemistry, Physics or Biology. By the mid 1950s most Nigerian secondary schools were operating the two-tier approach where every student was taught General Science for two years in a five year education programme. Students were allowed to specialize in the last three years in two or three subjects of their choice.

The West African Examination Council took over from Cambridge the School Certificate Examination in 1950. From that period changes were introduced to reflect the need to indigenise the content and scope of education in Nigerian secondary schools. In an effort to popularize science in the schools, science teachers all over the country met in 1957 to inaugurate the Science Teachers' Association of Nigeria. The Federal Government later established the Federal School of Science in Lagos in 1958.

SELF ASSESSMENT EXERCISE 1

When and where the teaching of science was first started in Nigeria?

3.2 Science Education in Nigeria since Independence

With independence in 1960, foreign technical aids started coming into the country. In 1962, Ahmadu Bello University established the Arts, Science and Technology branch. University of Ife also established the

College of Arts, Science and Technology. Primary Science Education was unco-ordinated. Some states operated Nature Study, Agricultural Science, Health Education etc, in their curricula while others operated the more modern and integrated curricula like those of the African Primary Science Project (APSP), the Mid-West Primary Science Project (MPSP) and the Primary Education Improvement Project (PEIP) of the Northern States. Classroom implementation of these curricula relied on reading and memorization of textual materials. There were no laboratories or facilities for science teaching apart from designated corners known as "Science corners" in classrooms. There were no qualified teachers to teach science as they learned little science if any, during training. Pupils were mainly trained to "remember" content-centred, examination oriented and not relevant to the child's world. These inadequacies were recognized by the provision for Primary Education with following generalizations to:

- Lay a sound basis for scientific and reflective thinking;
- Develop in the child the ability to adapt to his environment;
- Give the child opportunities for developing manipulative skills that will enable him to function effectively in the society within the limits of his capacity… (NPE, 1998)

Consequently, core curricula in Primary Integrated Science and Mathematics were developed by the Federal Ministry of Education for adoption nationwide. The Federal Government mandated and funded the Nigerian Educational Resource Development Centre (NERDC) to implement a National Primary Science and Mathematics Project (NPSMP) based on the curricula. With this project there was a shift from rote-learning, content-centred curriculum to the acquisition of the science process skill – an approach known as Science A Process Approach (SAPA). The NPSMP Integrated Science is organised into columns of topics, content, performance objectives, activities, suggested equipment and assessment questions.

Influenced by the wave of science reforms worldwide and the changing needs of the Nigerian pupils, the Science Teachers' Association of Nigeria (STAN) was invited by the West African Examination Council to spearhead the movement for change in school science. Subject panels were set up which developed curricula in Biology, Chemistry and Physics for the senior forms and later in Integrated Science for the Junior Secondary School. The effort of the association was supported by grants from the Comparative Education study and Adaptation Centre (CESAC) and the British Council/Curriculum Renewal and Educational Development Overseas (CREDO) in the United Kingdom. These efforts led to the production by STAN in 1972 of pupils' text and workbooks

and teacher's guide for forms 1 and 2 under the Nigerian Integrated Science Project (NISP). The intention of NISP materials was that science should be taught as "what is science and how a scientist works" (Ajeyalemi; 1983).

The separate science curricula developed by the Science Teachers' Association of Nigeria were taken over by the CESAC from which curriculum materials were developed for the Nigerian Secondary Science Project (NSSSP). These materials adopted for the conceptual-centre and scientific inquiry methods. The Federal Government also created the Ministry of Science and Technology in 1985 and launched the first National Policy on Science and Technology in 1986 all in a bid to boost Science and Technology education. In spite of these efforts many secondary schools lacked the basic facilities for science teaching. Some had no laboratories, the classes were over crowded due to population explosion in schools. Consequently, instruction was teacher-directed, textbook bound and examination oriented. Students learned science by reading and memorization of concepts. Practicals were delayed to the last few months before external examinations.

With the introduction of the 3 – 3 secondary education programme came a change in the broad aims of science education. These are preparation for useful living within the society and for higher education. The scope and content of the curriculum was upgraded; Integrated Science from two to three years and those at the Senior Secondary level beyond GCE O' level but not up to the advanced level standard. There is also a shift in the structuring of the science curriculum into conceptual units or themes and the content arranged in spiral sequence with each unit treated more exhaustively as the course progresses. The guided discovery approach was recommended and it is meant to provide students with experiences in science process skill and engage them in active participation in learning.

As regards tertiary science, Colleges of Education run a sub-degree course leading to the award of the Nigeria Certificate of Education (N.C.E). Science subject combinations offered include Mathematics/Chemistry, Physics/Chemistry, Biology/Chemistry, etc., and Integrated Science which counts as a double major. The content of the curriculum is up to and some times above G.C.E A' level standard.

A National Commission for College of Education (NCCE) was set up in 1988 in order to harmonize standard of courses offered in all the colleges. All universities run basic and applied science courses and majority of them run science teacher education programmes.

The Federal Government has given each of the conventional universities a mandate to maintain the 60:40 Science/Technology to Arts admission

ratio. This is because of the need for higher level scientific and technological manpower for the country to forge ahead. The course offered in the universities compare in terms of standards to courses in other universities worldwide in terms of objectives and content. However, they have often been criticised for being academic, theoretical and irrelevant to the needs of the Nigerian Society. The greatest problem faced by science student is that of lack of suitable textbooks, up-to-date journals and inadequate supply of modern equipment.

SELF ASSESSMENT EXERCISE 2

What are the names of the national bodies in charge of universities and polytechnics?

4.0 CONCLUSION

In this unit, you have learnt that the foundations of modern science education in Nigeria were laid between 1861 and 1897. Science education started as Nature study at Primary Schools and Teacher Training Colleges. You also learnt about the inauguration of the Science Teachers' Association of Nigeria in 1957 by Science teachers all over the country. The unit also exposed you to development of science education in Nigeria since independence when government and different curriculum agents were involved in shaping the teaching of science in Nigeria.

5.0 SUMMARY

Among the things you have learnt in this unit are: science education in Nigeria before the country gained independence from the British Government in 1960 as well as state of science education in Nigeria from 1960 to date.

6.0 TUTOR-MARKED ASSIGNMENT

1. What will you consider as impediment to the successful implementation of science education programmes in Nigeria since independence?
2. Discuss the contributions of some curriculum agents to the success of science education in Nigeria.

7.0 REFERENCES/FURTHER READINGS

Ajeyalemi, D. (1987) *Science Education in the Last Two Decades*: Are we really serious? In Ejiogu, A. M. and Ajeyalemi, D. (eds). Pg. 147 – 159.

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UNIT 3 SCIENCE EDUCATION IN NIGERIA II

CONTENTS

1.0 INTRODUCTION

In the last unit, you learnt about science education in Nigeria before and since independence. This unit also continues with the discussion on the same issues but from other perspectives. Here the discussion will centre on the new direction for science education development and the changing nature of things in the world as it affects science education in Nigeria.

2.0 OBJECTIVES

At the end of the unit, you should be able to:

- list the issues that can be regarded as the new direction for science education development in Nigeria
- discuss some of the issues listed above as it affect development of science education
- describe some of the occurrences in the world that is challenging science education in Nigeria.

3.0 MAIN CONTENT

1.1 New Direction/New Dimension for Science Education

Educational systems all over the world place serious emphasis on Science and Technology because of their implications on technological advancement which is tied to national development. This desire is the case with all developing nations including Nigeria. This being the case, the curriculum content of science education stands as a life wire through

which learners in schools are trained to attain goals in technological advancement. The content of science education curriculum therefore should be reviewed in line with the trends of events in our changing world and the need of the learners. There is need to adjust to and develop the fast moving world of Science and Technology. Computer Literacy, Information Technology, Population and Family Life Education, Environmental Studies on Environmental Population Degradation, Protection, Global Warming, Science Technology and Society Education, Scientific and Technological Literacy for all, empowering women in Science Technology and Mathematics Education, Bioethics, Genetic Engineering, Inhibiting factors within the school system are new directions/dimensions for science education. There is urgent need to inject meaningful innovations in the curriculum content of science education, innovations in terms of methodology (hands-on, minds-on, mapping, etc) research reports, manpower needs, curriculum development, etc.

There should be a re-think as far as instructional strategies in science education are concerned for meaningful learning to take place. Science teachers should devise ways of motivating students. The decline in the trend of students' choice of science subjects at the secondary school level is trend that must be nipped in the bud if Nigeria will attain its full technological potential in a changing world.

Science Education requires more massive funding. This is another direction the Federal and State Governments should have a re-think. There should be continuous government commitment to funding in the areas of science education and research in science education in line with the provision in the National Policy on Education that "a greater portion of University Education funding shall be devoted to Science and Technology.

In re-thinking science education in Nigeria, There should be determined efforts to re-shape the science teacher. He should be encouraged, exposed to trends, research findings and innovations in the area of science education through seminars, workshops, and conferences, long and short-term courses. This will help to keep him abreast of current developments in the field as well as improve his efficiency in the field.

There should also be a motivation and reward structure to attract and retain a substantial percentage of the society in the mainstream of science education.

The current situation in university education and science based courses where many graduates roam the streets unemployed or under employed is another dimension that needs a re-think. Universities should seek

ways of linking science educations with productive work. Science education should be aimed at solving societal problems not compounding them. If the reports on rationalisation of courses in universities are faithfully implemented, if universities improve their funding through endowments and consultancies and if the government gives adequate funding for science education there may still be hope for reactivating and redirecting science education to meet the challenges/demands for a future generation in a changing world.

The formation of Junior Engineers Technicians and Scientists (JETS) club and organization of science fairs by the Ministry are steps in the right direction in the promotion of science and technology education. More importantly, the Ministry should promote the improvement of science learning through funding and research as does the National Science Foundation (NSF) in the United States of America. Again, monitoring of quality and standards in classroom instruction should be taken seriously by the Inspectorate Division of the Ministry of Education because, not much is being done in this regard.

SELF ASSESSMENT EXERCISE 1

How can government re-shape science teachers for better performance in our schools?

1.2 Changing World and Science Education

The world is changing everyday. Science and technology education which are vehicles for technological advancement and national development have to change too. There are changes in the area of information technology. Computers are used in virtually every facet of life. They are used in surgery, in business and at the airports to display information. Engineers use computers to design air craft. Immigration Departments use computers to process applications. Traffic lights are controlled by computers. At home, computers are used as washing machines and for playing games. They are used in school for recording scores, marking examination papers, organising the time table and other schedules. The internet has brought the world into such a close unit that one can obtain information from any part of the world. Computers have as a matter of fact brought revolutionary changes in the state of the world, giving us a new form of civilisation in all aspects of life. In view of all these changes there is an urgent need for our science educators and curriculum planners to make science education functional to meet the needs of the hour. This is in line with the observation of Nedosa and Esseyin (2001) that “computers have now invaded Nigeria and almost all activities are now being computerised. To cope with these changes, our students need to be computer literate.

Medical scientists have not been able to find out the causes of cancer or how to cure the various viral diseases including HIV, which have infected a lot of our people. Man is faced with multifarious environmental problems and challenges that man himself or science has introduced into the environment. Atmospheric pollution brought about by burning fuels has changed the face of world. There is an increase in the level of carbon oxide gas in the atmosphere which in turn has led to global warming. Global warming refers to the constantly increasing mean temperature of the earth manifested in the high rate of degradation of the Arctic and Antarctic regions of the world.

Our water bodies are polluted by heavy metals from the mining activities of our people. Sewage and industrial wastes emptied into waterways have done damaged to water. The use of chemicals like Gamalin 20 has done a lot of damage to aquatic life in these water bodies.

Incessant felling of trees for firewood and timber has destroyed our mature forests making them prone to desertification and erosion which are now serious threats to many parts of Nigeria. For instance, in the southern parts, erosion has destroyed a lot of farmland, access roads, houses and even lives.

In the field of education in spite of the effort of the government to improve science education, students still perform poorly in science teaching and learning. The Federal Government admission policy of 60:40 in favour of sciences for university education has not been met. The problems of population explosion in our schools have not been solved.

Many more changes and challenges are still on the way because the world is not static. It is only through well-planned science education programmes drawn in line with these challenges and changes that we may hope to make the world a better place to live in.

SELF ASSESSMENT EXERCISE 2

What are the merits and demerits of science and technology to the human race?

4.0 CONCLUSION

This unit, shows that the new direction to the proper development of science education in Nigeria are: to have a re-think in instructional strategies, re-shape science teachers, re-think on unemployment of the

young science graduates, formation of science clubs, etc. It also explains issues about the changing world and science education with reference to the benefits and hazards of science and technology.

5.0 SUMMARY

This unit explains the need for our science curriculum to reflect the new dimensions for science education, such as Information Technology, Computer Literacy, Population and Family Life Education, Global Warming etc. It also emphasises how to re-shape our science education to achieve the national goals. The units also discuss some merits and demerits of science education at a global level.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss better ways by which government and private sectors can re-shape science education in Nigeria.
2. What challenges does HIV, Global Warming, Pollution, Computers, etc pose to the development of science education in Nigeria?

7.0 REFERENCES/FURTHER READINGS

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UNIT 4 TRENDS IN THE GOALS OF SCIENCE EDUCATION

CONTENTS

1.0 INTRODUCTION

This unit traces the past goals of science education which appeared to be mainly for acquisition of science knowledge. The current goals of science education include acquisition of science literacy, the development of independent learning skills and application of science to solving societal problems

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss the goals of science education
- list the attributes of scientific attitudes
- describe the qualities of a scientifically literacy person
- describe how to achieve the goals of science education.

3.0 MAIN CONTENT

3.1 The Goals of Science Education

The goals of science education at the school level are that of making students acquire the knowledge of science and understanding of nature as well as appreciating science as a field of disciplined inquiry.

There were several problems associated with the teaching of science purely for the acquisition of knowledge because it has led to a mis-

representation of science. Teachers taught the knowledge (facts, concepts and principles) of science in a dogmatic fashion. Schwab (1962) reported that to teach science as a 'dogma' would mis-represent the facts about the nature of scientific enquiry. This approach also creates tension between science as it is practised, and science as it is presented in science textbooks (Siegel, 1978). The teaching of science mainly for the acquisition of knowledge has also led to the development of passivity, docile learning and dependence on teachers and textbooks instead of an active learning in which lecturers and textbooks are challenged.

At the rate science is developing, it seems impossible to teach students all the scientific information they will need. Instead, Booth (1978) suggests that children should be given opportunities to discover, invent and get caught up in the rapid expansion of scientific and technological information. It is more appropriate to teach students how to learn; to have them acquire the skills that will enable them learn on their own; and to provide them with a foundation of skills and attitudes for acquiring and processing knowledge so that they will be adequately prepared to deal with changes in the future.

It is not that scientific knowledge is not important, but it is certainly not sufficient to teach science only for the sake of knowledge. It appears that it will be more beneficial to identify the fundamental aspects of science (basic conceptual models) and represent them with a general education, emphasis involving topics presented in a personal and social context and to carry this out in such a way that the full range of the cognitive level is emphasised, especially when it is known that the majority of secondary school students will not do much science after this level.

Another goal of science education added in the recent past was the development of a scientific attitude. The concept "scientific attitude" implies behaviours that demonstrate accuracy, honesty, open-mindedness, objectivity, non-bias, scepticism and possession of a critical questioning and rational mind (Gauld, 1973, 1982). According to the Education Policies Commission of United States, possession of a scientific attitude, aside from being the mark of a scientifically-minded person, is also the mark of rational one and would naturally seem to represent predispositions appropriate for solving problems in everyday life. This is perceived as beneficial for the individual and society alike.

The current goals of science education include developing scientific literacy which requires making learners to understand the impact of science on them as individuals and as members of the society.

SELF ASSESSMENT EXERCISE 1

List some other scientific attitudes apart from the one mentioned in this unit.

3.2 Qualities Expected of a Scientifically Literate Person

- Recognise that scientific concepts (e.g. velocity, force, energy and photosynthesis) are invented or created by acts of human intelligence and imagination and are not tangible objects accidentally discovered.
- Comprehend the distinction between observation and inference and discriminate between the two processes in the scientific context under consideration.
- Distinguish between the occasional role of accidental discovery in scientific investigation and the deliberate strategy of forming and testing hypotheses.
- Comprehend the limitations inherent in scientific inquiry and be aware of the kinds of questions that are neither asked nor answered.

3.3 How to Achieve other Goals of Science Education

- Organise activities around or orient activities towards the real world of problems, including value-laden issues.
- Organise activities, around or orient activities towards issues related to students needs recognising the use of the natural environment and community resources can be very useful. When using informal learning settings, be familiar with the setting so that before the activity, you can help students acquire sufficient knowledge about what to look for and what to expect so that they will be comfortable in the informal, free-choice setting and will get as much out of it as they can.
- Consider career education and subsequent learning about the science involved in certain careers, have the students actively involved in doing and observing what people in specific occupations actually do, and
- Deal with students' misconceptions, make students aware of them and help them identify their misconceptions. Also, help them "learn how to learn" and "learn how knowledge is constructed" as this can be useful in dealing with this problem.

SELF ASSESSMENT EXERCISE 2

Mention the qualities you as a science teacher will expect the students in your class to possess.

3.4 Implications of the Goals of Science Education for Teaching

Since the goals of science education is aimed at all ages of learners of all abilities and interests, it appears many changes need to be made in classroom teaching. Many reviews of studies on science teaching in Nigeria indicate that the focus is the learning of content. Although, that is a part of some perceived goals, the process being used towards that end is in conflict with other goals.

The courses to be thought need to include content and processes towards problem resolution, using appropriate value sensitivity. Science teachers need to apply multiple teaching strategies, focusing on learners' needs towards making what is learned relevant to all learners.

Humphreys *et al*. (1982) in analysing several studies found co-operative learning to be more beneficial towards increasing students' achievement than either competitive or individualistic learning settings although they recommend the occasional use of competitive or individualistic learning settings when appropriate. Wise and Okey (1983) in a meta-analysis, and Okey and Butts (1982) in an analysis of several studies found focusing discussions, making students aware of and careful planning towards objectives, frequent feedback on progress but not indicating an evaluative nature from the teacher, student's physical interaction with materials and a wide range of activities for students and longer wait-time all enhanced achievement of instructional objectives. Anderson (1983) in a consolidation of meta-analysis concluded that there is evidence supporting the use of inquiry teaching towards greater student achievement. However, the use of multiple teaching strategies including inquiry teaching should be adopted by all teachers in order to meet the requirements of different learning styles in the classroom.

4.0 CONCLUSION

In this unit, you are expected to have learnt the goals of science education which include the development of scientifically literacy, career awareness, teaching students to learn, how to learn and the application of scientific knowledge to solving societal issues, qualities expected of a scientifically literate person, how to achieve other goals of science education as well as its implications for teaching.

5.0 SUMMARY

This unit discussed the following:

- The goals of science education at the school level are to make students acquire the knowledge of science and the understanding of the nature of science.
- The need for the development of scientific attitudes
- The need for the development of scientific literacy
- Qualities of a scientifically literate person
- Implications of the goals of science education for classroom teaching.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss how the goals of science education can be successfully achieved at the secondary school level in Nigeria.

7.0 REFERENCES/FURTHER READINGS

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UNIT 5 CONTENTS OF SCIENCE EDUCATION

CONTENTS

1.0 INTRODUCTION

In the last unit, we looked at content in a broad sense. Now, we will do a little recap and bring in new perspectives to the subject. We will examine content peculiar to the Nigerian context as revealed in the trends, and why content has changed over the years.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the term "content" as used in the science curriculum
- describe briefly the trends in the content of science output technology
- discuss some criteria used in identifying and selecting content
- explain why the content of science has changed over the years.

3.0 MAIN CONTENT

3.1 Meaning of Content

The term content is used to refer to the materials selected to be taught or learned. It constitutes the subject matter the teacher is expected to assist learners to learn in a discipline. This will include the knowledge, skills, attitude, values and ethics deemed necessary for the learner to acquire.

Onyike (1996) describes content as the knowledge, skills, concepts, principles, attitudes and values to be learned. To Ehindero (1986) curriculum content involves "providing opportunities for students to learn and utilise skills, processes, attitudes and values". Content may be

viewed as selected relevant knowledge, skills, attitudes and values considered appropriate for the functional development of the learner. It is necessary that what would be considered good content must be relevant to the learner and help him to be useful to himself and the society.

SELF ASSESSMENT EXERCISE 1

What is content?

3.2 Trends in Contents in Science Education

The society we live is dynamic. The changes in the society coupled with the changes in the needs of man has greatly influenced and is still influencing the science education curriculum, bringing about a shift in the content of what is learned to accommodate such changes. The trends in the contents of science education therefore reflect where we are coming from, where we are going.

It is important to note that content is not selected in isolation of the goals and objectives. Whatever is selected must be such that will bring about the accomplishment of attainment of the goals and objectives of science education for which they are selected. Based on this premise, the trends in the content of science education is determine mostly by the objectives science education seeks to achieve at any particular time.

The introduction of science education in the Nigerian educational system can be traced to 1895 when the church missionary schools were established in Lagos (Omolewa, 1977). Science then, according to the author was taught as nature study. The content was predominantly on agriculture and some environmental issues. Learners were expected to observe plants, animals and non-living things.

By 1920, it was observed that nature study was inconsistent with the psychology, philosophy and general objectives of education of the time (Bajah 1982). This leads to the introduction of general or basic science. Subject matter that was selected as content during this era was that which could invoke and foster scientific thought and method. Science then was mostly for knowledge acquisition and so the content was a collection of short topics drawn from several aspects of the sciences.

Although, science hadn't a strong bearing in Nigerian education history until the 1969 curriculum conference, the launching of the first satellite (Sputnik) into space by the Soviet Union in 1957 had a dramatic influence in the growth and development of science globally especially in U.S.A. It triggered off a world-wide movement for a broad based and

more functional science. During this era Nigeria shifted from basic science to compartmentalised (separate) science subjects namely – physics, chemistry and biology. Content was selected and organised in these individual subjects. Although this approach to the organisation of science content is still in vogue, much criticism has been levelled against the system. Such include, its lack of coherence among subjects, its irrelevance to solving everyday society's problems.

Some of the above stated limitations gave room for the introduction of the integrated science (courtesy of STAN), an approach that brings these subjects into one umbrella subject. Under the integrated science, the contents of the subjects are organised to show relationships among students and how they could be used to solve real life's problems. This makes science more meaningful. However, integrated science is still limited to the junior secondary school.

It is important to state here that at the primary school level, science is taught as primary science, general science or elementary science. The content reflects the current science objectives. The trends in science content is far more elaborate and is a continuous one so as to meet the ever changing societal needs and aspirations which are reflected in the objectives of science education at various stages of its development.

SELF ASSESSMENT EXERCISE 2

Why was nature study regarded as being inconsistent with Nigeria philosophy of education?

3.3 Criteria for Identifying and Selecting Contents

It is crucial to remark that the development in science and technology has brought about knowledge explosion. Equally important is the fact that not everything can be learned at the same time. Similarly, societal needs of any nation are reflected in its educational policy and the curriculum becomes the mirror of these needs, and setting the stage to meet these needs. To this end, it becomes imperative that only those contents that are needed at a time will be selected. Thus, criteria must be set so that only those things that will bring about the actualisation of the objectives of the educational policies are identified and selected as content.

The following criteria may be used in identifying and selecting content:

- **Validity**

The validity of content can be explained in two ways. First, validity of content refers to the ability of such content to bring about the attainment of set goals and objectives. So, for anything to be included as content, it must be related to the objectives they are selected for. One other aspect of validity is how true the subject matter is. Taking into consideration the rapid accumulation and changes in knowledge, what was considered a breakthrough in the past is today obsolete. This calls for continuous strutting of knowledge before it is selected as content.

- **Learnability**

This is concerned with the ability of the learner to grasp what is selected for learning. Learners learn at different levels. The implication is that the ability of the learners for which any content is selected must be taken into account. Contents that are beyond or below the ability level of the learners will make mastery difficult or impossible.

- **Utility**

Utility implies the usefulness of the content. Content is said to be useful when it is meaningful to the learner – meaningful in terms of application to real life's situations. For any subject matter to be considered for selection, it should be that which enables the learner apply whatever is learn to his daily life and find solutions to his problems. This criterion emphasises the relevance of content to real life's situations. It implies finding meaning in what is learned as it relates to the learner and the society.

- **Interest**

This is another important criterion that must be given attention in selecting content. The interest of the learner is a fundamental factor in inculcating the right knowledge, skills, values and attitudes that the curriculum seeks to attain. Interest helps in sustaining concentration, purpose and commitment and co-operation with the teacher in the teaching – the learning process.

It is however, necessary to be cautions in applying this criterion as not all that interests the learner may be worthwhile and not all that is worthwhile interests the learner. Here, the teacher plays an essential role in shaping the interest of the learner.

While these criteria may not be conclusive, they should guide any science curriculum planner in selecting what should be included as content. For an effective selection of content, the selection should not be done in isolation of other processes such as objectives, learning experience etc. The criteria discussed are also interrelated and so should not be considered as independent in the selection process.

SELF ASSESSMENT EXERCISE 3

List the criteria you will use in identifying and selecting content for the science curriculum.

3.4 How and Why Content has changed over the Years

As it is always said, the only thing that has remained constant is change. All other things have always changed including science content. Many reasons have been advanced as responsible for this. Okeke (1996) identified the following:

- Change in the objectives of education emanating from change in social values, beliefs, traditions, etc
- Change in the nature of knowledge or content of education
- Change in what is known about the learning process
- Change in the system of education
- Change necessitated by feedback from curriculum evaluation.

The reasons for change in science content will be discussed under the following:

- Change in national aspirations
- Knowledge explosion
- Development of new theory and curriculum design
- Global revolution

Change in National Aspirations

Every society has what it wants to transmit to it members in form of education. A change in these societal ideals will result in the change of curriculum content. Since independence Nigeria has witnessed series of shift in the content of its science curriculum to meet its aspirations in the bid to provide its citizens with basic science education and to catch up with global advancement in science and technology. The country's national policies on education reveal these aspirations at various times.

Knowledge Explosion

One of the fields of study that has witnessed exponential growth in knowledge over the years is science. With this knowledge expansion many issues beg for attention while some become obsolete. There is need to sieve through for the relevance. This may account for change in the content of science education so as to accommodate the need and the ideas and to exclude invalid ideas. This must be considered in line with what was obtainable as the content of science education at such times.

Development of Theory and Curriculum Design

Theory is a product of science. Science education like any other field of learning and particularly educational activities is heavily guided by theories. Theories serve as guide to the curriculum planners in the selection of objectives, contents, methods etc. Many great theorists such as Bloom, Dewey, Piaget, and Brunner have in various forms influenced the curriculum process in many fields of study including science education. Disciples of these theorists have at one time or the other changed science content to reflect such theories.

Similarly, the choice of curriculum design has also influenced the change in the content of science education. There are many types of curriculum designs such as the teaching-centred, the child-centred, the integrated or interdisciplinary, the compartmentalised designs etc. Whichever is adopted at any time will influence the content. For instance, what is included as individual science subjects-(chemistry, physics and biology) under the compartmentalised design differs from the interdisciplinary design that reflects integrated science.

Global Revolution

No nation is an Island. The growth and development of science in one nation pose a challenge to the others. A case in point is the launching of the sputnik by the Soviet Union in 1957. This advancement saw a great revolution in the field of science, especially in U.S.A. It so challenged the United States that there was a total transformation in US science education in all ramifications. Nigeria too is not left out in the struggle to meet up with the challenges of world science and technology. This is marked by a drastic change from the liberal arts to much concentration on science and technology. This is influenced by the content of science education.

SELF ASSESSMENT EXERCISE 4

What are the reasons for the change in the science curriculum content?

4.0 CONCLUSION

This unit, explains the meaning of content, the trends in the contents of science education as well as criteria for identifying and selecting content. It also explains the changes that have occurred in the educational setting as well as the reasons for these changes.

5.0 SUMMARY

All that you have read so far is to help you as a science teacher to understand that the content of science education is dynamic. That is, the material selected to be taught and learned in science should be prone to change.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain with reference to the science curriculum, the term "Content"
2. List and discuss the criteria for selecting content in any science subject taught at the secondary school level.

7.0 REFERENCES/FURTHER READINGS

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UNIT 6 SCIENCE EDUCATION CURRICULUM REFORMS IN NIGERIA I

CONTENTS

1.0 INTRODUCTION

This unit will examine the roles played by Science Teachers' Association of Nigeria (STAN), Comparative Education Study and Adaptation Centre (CESAC) and Nigerian Educational Research Council (NERC) at reforming science curriculum in Nigeria.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- state the aims of STAN
- mention the functions of CESAC
- describe the roles played by the three bodies in reforming science education curriculum in Nigeria.

3.0 MAIN CONTENT

3.1 The Role of STAN in Science Education Curriculum Reforms

The STAN is a professional body inaugurated in October, 1957 in the lecture theatre of Kings College, Lagos through the efforts of Late Chief F. I. Ajumogobia and other founding fathers of STAN namely; Professor

Chimere Ikoku, Tunde Yoloye and Messrs. Dotun Oyewole, Femi Oyewole and J. A. Bamijoko. The aims of the Association at its inception according to STAN (1973) were:

- To promote cooperation among science teachers in Nigeria with a view to raising the standard of science education in the country.
- To provide a forum for discussion by science teachers on matters of common interest.
- To help science teachers keep in touch with the development in science and its application to industry and commerce
- To popularise science
- To cooperate with and affiliate to other societies and bodies with related interest.

Since its inauguration, the Association had over the years devoted its effort to science education curriculum innovation and renewal by translating national and educational objectives into curricula and teaching objectives through the development of curricula designed to help individuals attain cognition, acquire process skills and develop positive attitudes to science. All these would afford the students the opportunity to think critically, manage and use available resources within their environment effectively.

Sequel to the request from West African Examinations Council (WAEC) to critically examine and revise the existing syllabus in the various science subjects and with financial assistance from USAID, the national executive of STAN constituted 3 Curriculum Development Committees (CDC) to work on integrated science, chemistry, biology and physics curriculum. The terms of reference of the CDC as cited by Bajah (1985) were:

- To review and revise the existing science curriculum.
- To produce teachers and pupils' materials relevant to the revised syllabus
- To perform such other functions connected with science curriculum development as the STAN executive may from time to time direct
- To cooperate with any other science curriculum development groups to achieve these ends.

The report of CDC gave birth to the Nigerian Integrated Science Project (NISP) with the set of materials comprising pupils' textbook, pupils' workbook and teachers guide, all published in 1971 and introduced into secondary schools in 1972. The NISP basic philosophy according to STAN (1970) was to teach students what science is and how scientists work. It should be noted that this was the first time integrated science was introduced into secondary schools; it was formerly called general

science. To further promote NISP, between 1978 and 1980, STAN carried out an extensive revision of the project in line with the new National Policy on Education. The result of this revision was the production of three books (with workbooks and teachers guide) for the first three years of the 3-3 secondary education system. The Book 1 was published in 1982, Book 2 in 1983 and Book 3 in 1984.

In view of the general public quest for locally produced textbooks that would cater for individual differences, conceptual difficulties, reading difficulties, local examples and cultural heritage, STAN commissioned some of her members to write textbooks on the new school certificate syllabus in physics, chemistry and biology. The biology textbook was published in 1983 while chemistry and physics textbooks were later to be published. Since then, STAN has progressively been producing other textbooks not only for secondary school science but also for primary school science.

To properly address the issue of quality control, only the experienced members of STAN were selected from all parts of the Federation for the writing workshops. These workshops are usually organised by STAN in the various subject panel. There are twelve of such subject panels. These are agricultural science, biology, chemistry, physics, mathematics, technology, teacher education, integrated science, primary science, environmental education, science technology society (STS), physical and health education. The subject panels were also mandated to organise a week-long annual workshops on various strategies for teaching and learning science in order to make science more enjoyable and less difficult for both science students and teachers.

SELF ASSESSMENT EXERCISE 1

1. What is the basic philosophy of NISP?
2. How far have we achieved this philosophy at the secondary school level?

3.1.1 A List of Textbooks produced for Primary, Secondary and Teacher Education by STAN

S/N	TITLE	CATEGORY	CLASS-IFICATION	PUBLISHER
1.	STAN Primary Science	Pupils' Book	1 – 6	University Press, Plc
2.	STAN Primary Science	Teachers' Guide	1 and 2	"
3.	STAN Primary Science	Workbooks	1 – 6	"
4.	Nigerian Integrated Science Project (New Edition)	Pupils' Textbook	1 – 3	Heinemann Educational Books (HEBN)
5.	Nigerian Integrated Science Project (New Edition)	Pupils' Workbook	1 – 3	"
6.	Nigerian Integrated Science Project (New Edition)	Teachers' Guide	1 – 3	"
7.	STAN Chemistry for Science Secondary Schools	Students' Book	SSS	"
8.	STAN Biology for Senior Secondary Schools	Students' Book	SSS	"
9.	STAN Physics for Senior Secondary Schools	"	"	"
10.	STAN Mathematics for Junior Secondary Schools	"	1 – 3	University Press, Plc
11.	STAN Mathematics for Senior Secondary Schools	"	"	"
12.	STAN Agricultural Science for Junior Secondary Schools	"	"	Longman Nigeria Plc
13.	STAN Agricultural Science for Senior Secondary Schools	"	"	"
14.	STAN Further Mathematics for Senior Secondary Schools	"	"	University Press, Plc
15.	STAN Science Teachers	Hand book	-	Longman Nigeria Plc.

Another way by which STAN contributes to knowledge is through the publication of the *Journal of Science Teachers Association of Nigeria* (JSTAN) twice a year. JSTAN deals with topical issues and research in science education. The journal had 40 volumes from 1961 – 2005. STAN also publishes the proceedings of its annual conference every year, *STAN Bulletin, History of STAN* and also position papers.

STAN has also over the years been organising annual conferences for its members thereby enriching their professional growth. The annual conferences serve as a forum for the exchange of ideas and for reporting research findings during paper presentations by scholars from universities, polytechnics, colleges of education and schools.

SELF ASSESSMENT EXERCISE 2

Take your time to go through all the STAN publications for secondary school and write out the names of the members of the team that wrote the texts.

3.2 The Role of CESAC in Science Education Curriculum Reforms

CESAC was established in 1968, as a support to national effort to evolve a more suitable system of education that is continually adapted and responsive to the nation's economic and social aspirations. Part of the Centre's functions at inception includes the following (CESAC, 1983)

- To promote the modernisation of curricula in Nigeria at all levels and to introduce change and innovation into our educational system through curriculum development and renewal.
- To engage in original research in the field of comparative education and curriculum development.
- To arrange from time to time well prepared reconnaissance survey of general and technical education in foreign countries with a view to investigating recent developments in approaches and techniques as would be adaptable to the Nigerian situation.
- To organise teacher education programmes for the introduction of new approaches and for the professional growth of teachers.
- To assist in the preparation and publication of curriculum materials and textbooks developed by the Centre.

The educational activities of CESAC on curriculum development were centred on the secondary level with special attention directed at six school subjects namely: sciences, mathematics, technical and vocational studies, social studies, English language and moral education. Other

science related subject areas covered include the following: woodwork, metal work, technical drawing, and auto-mechanics, building construction, basic electronics and applied electricity.

All these subjects are science related subjects which are examined annually by WAEC at the senior secondary school level. Other non-science subjects developed by CESAC included business studies, typewriting, shorthand, book-keeping, accounts, home economics, home management, food & nutrition, clothing and textiles and moral education.

CESAC's efforts at reforming the science education curriculum of secondary schools were strictly guided by its philosophy of active learner participation. This process is achieved when students are encouraged to learn by inquiry and self discovery, guided by the teacher.

Under this approach, students were encouraged to learn by inquiry and discover concepts and generalisations based on their experiences. Manipulative skills that are necessary for designing and conducting experiments relevant to laboratory work were also emphasised.

With financial assistance from the Ford Foundation in America and in cooperation with STAN, CESAC set up various curriculum development committees. The reports of these committees led to the new syllabi in biology, chemistry, physics which in WAEC regulations and syllabus is referred to as alternative syllabi. CESAC also set WASC examination questions on these syllabi.

These syllabi were later used as basis for developing the National Senior Secondary School Syllabi in science subjects between 1984 and 1985. CESAC developed and subsequently published instructional materials in form of students texts and teachers guide in 1970, known as the Nigerian Secondary School Science Project (NSSP) in biology, chemistry and physics for forms 3 – 5.

CESAC also operated regular long vacation training courses for science teachers throughout the country. These training courses were designed to familiarise science teachers with the use of the many project materials developed by the centre.

Prior to 1988 when CESAC was finally merged with other bodies, the centre was able to publish about 50 instructional materials consisting of pupils and teachers' textbooks. It also published 23 volumes of its occasional publications and in addition 12 volumes and 2 special editions of its maiden curriculum journal called The *Journal of Research in Curriculum* (JORIC).

SELF ASSESSMENT EXERCISE 3

List some of the text materials published by CESAC and their years of publication.

3.3 The Role of NERC in Science Education Curriculum Reforms

The NERC's efforts in revolutionalising the science education curriculum at the primary school level began with the publication of the report of the 1969 Curriculum Conference. Based on the report of this Conference and the subsequent publication of the Federal Ministry of Education document titled "Core Curriculum for Primary Science", the NERC commissioned in 1971 the National Primary School Science Project (NPSSP) with the production of primary science materials (text and equipment). This project revised and later in 1982 became known as the National Primary Science and Mathematics Project (NPSMP).

The NERC together with other science curriculum reform bodies like STAN, CESAC, etc got involved in the development of the Federal Ministry of Education "Core Curriculum for Integrated Science" for Junior Secondary Schools. The NERC between 1977 and 1985 also distributed the new syllabus (based on the proposed 6 – 3 – 3 – 4 system of education) on integrated science (JSS 1 – 3); biology, chemistry and physics (SSS 1 – 3).

The NERC also launched a programme on the development and production of Teachers Manuals in Science for pre-service and in-service Universal Primary Education (UPE) Scheme Teachers (Bajah 1985). It also on a regular basis, organised a number of science education workshops for teacher trainers. The NERC was later merged with some other curriculum agents in 1988 to form a new body known as NERDC.

SELF ASSESSMENT EXERCISE 4

Look for any two of the NERC and STAN publications on any science subjects at the secondary school level. Write out the authors and the pattern of organisation of the topics

4.0 CONCLUSION

This unit has identified the roles played by STAN, CESAC and NERC in Nigeria as well as examined the details of the science education curriculum innovative projects undertaken at the primary and secondary school levels in the country.

5.0 SUMMARY

This unit has mentioned the founding fathers of STAN, the aims and efforts made in promoting science teaching and lists of textbooks published by STAN. It has also mentioned the functions as well as the contributions of CESAC and NERC to the improvement of science education in Nigeria.

6.0 TUTOR-MARKED ASSIGNMENT

1. Which of the three bodies, STAN, CESAC & NERC contributed most to the development of science teaching in Nigeria? Support your choice with facts.
2. There is the need for frequent reformation of science curriculum in Nigeria. Justify this statement.

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UNIT 7 SCIENCE EDUCATION CURRICULUM REFORMS IN NIGERIA II

CONTENTS

1.0 INTRODUCTION

This is a continuation of Unit 6. In this unit the roles of West African Examinations Council (WAEC) and Nigerian Educational Research and Development Council (NERDC) in science education curriculum reforms in Nigeria are examined.

2.0 OBJECTIVES

At the end of the unit, you should be able to:

- discuss the roles played by WAEC in reforming science education curriculum in Nigeria
- list the curriculum development bodies that merged together to form NERDC
- mention the functions which NERDC is expected to perform
- discuss the roles played so far by NERDC in the reformation of science education curriculum in Nigeria.

3.0 MAIN CONTENT

3.1 The Role of WAEC in Science Education Curriculum Reforms

The establishment of WAEC as a separate council to cater for and conduct examinations in West Africa can be traced back to 1948 when the Local Examinations Syndicate of the University of Cambridge and

the Schools Examinations and Matriculations Committee of the University of London opened discussions on it.

The report submitted by Dr. G. B. Jeffery, the then Director of the Institute of Education, University of London after his tour of the Gambia, Sierra Leone, Ghana (formerly Gold Coast) and Nigeria strongly recommended the proposal for the setting up of a West African Examinations Council, with details of its composition and duties.

The Jeffrey Report published in March, 1950 was accepted by the governments of the four British Colonies and the Ordinance establishing it was drafted in 1951. The Ordinance empowered the council to conduct examinations and award certificates equivalent to those obtainable in the United Kingdom.

The legislative Assembly of Gold Coast in December, 1951 was the first of the four colonies to pass the ordinance for the establishment of the council. A temporary office was therefore set up by the council in Accra with the first Registrar of the council named Mr. Kenneth Humphreys.

In 1953, the Nigerian government ratified the establishment of the council in Yaba as the WAEC office.

Since its establishment, WAEC has been the only examination body in Nigeria charged with the responsibility of conducting all examinations and also determining and approving all examinable syllabi at the secondary school level. The power of being the only examination body in Nigeria was sustained till October, 1999, when Federal Government of Nigeria announced the establishment of another examination body known as National Examinations Council (NECO). For some years from 1960 – 1995 WAEC influenced to a great extent the development of science education in Nigeria. The body is not a curriculum development organisation but its activities especially through its various examinations have made considerable input into the subject matter of the content of science teaching.

In 1968, WAEC felt the need to revise the school syllabus; hence the body invited STAN to do the revision of science subjects' curricula at secondary school level. The outcome of the exercise was the revised WAEC syllabus in science subjects introduced in 1974. This revised syllabus laid more emphasis on the utilisation of practical work as the basis of modern science teaching. Since then, subsequent minor revisions have been carried out on this syllabus every five years.

As Bajah (1985) noted on the revolution in WAEC examination practical in science subjects, "… there was a shift from the use of

foreign specimen to local species. Biology witnessed a determined effort on the part of WAEC to explore and use the local flora and fauna. In addition, the syllabus content was consistently modernised in the way of science education concepts. In chemistry for instance, the gradual progression form "trival" chemical names to the new IUPAC names was significant…"

The life span of a WAEC syllabus is five years. By the third year of usage arrangements are often made to review the syllabus by the syllabus review panel, which later submits a draft of its proposal to the Examination Committee of the Council for proper critique and subsequent approval.

Over the years, WAEC apart from being involved in setting public examination papers has also consistently and sufficiently influenced the content of what is to be taught in schools. The innovations in WAEC syllabus have always been reflected in the mode and type of examination questions set. The first public examination conducted by WAEC was in 1955, and since then, it has conducted examinations yearly up to date.

The question papers set and prepared by WAEC annually, are usually the achievement type in which every participating student achieves according to his/her ability. To set these questions, the body invites many seasoned science teachers who are commissioned to write questions into a pool where such questions they are moderated and tested accordingly.

WAEC also has a research division with many experts drawn from various fields of education such as measurement and evaluation, educational psychology and curriculum development who carry out research studies on the council's test development procedures, examination administration, teacher effectiveness and learners' conceptual difficulties. The research division of the council also organizes a monthly seminar where results of scholarly research studies are presented and discussed. Recently, this unit has also been involved in journal publications of articles.

SELF ASSESSMENT EXERCISE 1

Look for WAEC syllabus of 1985, 1990, 1995, 2000 and 2005. Are there any changes in them for biology, chemistry and physics? Briefly list and describe these changes.

3.2 The Role of NERDC in Science Education Curriculum Reforms

The NERDC was established by Decree No 53 of 1988 by merging four curriculum development bodies together. These were:

1. The Nigerian Educational Research Council (NERC)
2. The Comparative Education Study and Adaptation Centre (CESAC)
3. The Nigerian Book Development Council (NBDC)
4. The National Language Centre (NLC)

Some of the functions of NERDC as stated under the Decree that established it are:

- Encourage, promote and co-ordinate educational research programmes in Nigeria.
- Identify educational problems in Nigeria in which research is needed and establish the order of priority.
- Identify language problems for the purpose of carrying out research into such problems and finding solutions.
- Establish and maintain a research and development of library to which new educational books and other related publications may be deposited.
- Promote the development of curricula at all levels of the education system.
- Formulate and implement a national policy on book development
- Advice and implement all policies relating to language.
- Sponsor national and international educational conferences as may be relevant to the functions of the council.
- Organise teacher education programmes for new techniques.

These functions together with others not stated are undertaken through research, workshops, seminars and conferences. To enable the council carry out many of its functions, it is restructured and organised in six collaborating academic centres. They are:

- The Book Development Centre
- The Curriculum Development Centre
- The Educational Research Centre
- The Language Development Centre
- The Library and Information Centre
- The Special Programmes Centre.

The major curriculum activities of the council are carried out by the Curriculum Development Centre whose functions include:

- Development of Curriculum content
- Development of instructional materials
- Organisation of teacher education programmes
- Evaluation of curricula use in the school system
- Dissemination of research findings and reports
- Collation of information for comparative studies

The extent to which the council has been involved in the reformation of science education curriculum in schools could be gauged through the development and production of instructional materials in the area of science education. To date, with assets and liabilities taken over from NERC and CESAC, the council has developed the core curriculum for primary science and mathematics and has produced instructional materials for both pupils and teachers. Some of the council publications are:

- Primary Science Books 1 – 6
- Primary Science Teachers' Guide
- N.P.S.M.P Integrated Science Books 1 – 6
- N.P.S.M.P Integrated Science Teachers' Guide
- Integrated Science for JSS Books 1- 3
- Agriculture for JSS Books 1 – 3
- Biology Pupils Books 1 – 3
- Biology Teachers' Guide
- Chemistry Pupils' Books 1 – 3
- Chemistry Teachers' Guide
- Physics Pupils' Books 1 – 3
- Physics Teachers' Guide

At the Junior Secondary School (JSS) level all the 18 listed subjects in the National Policy on Education (1998) including integrated science, agricultural science, and introductory technology have been developed by the council and approved by the national council on education (NCE). For the Senior Secondary School (SSS) level, all the 38 distinct subjects (including biology, chemistry, physics, mathematics, agricultural science etc) that were listed in the national policy on education (1998) have their curriculum content developed by the council with the production of appropriate instructional materials for both the students and their science teachers'. These include textbooks, workbooks and teachers guides. In addition, some science and mathematics equipment have been designed by the council and produced locally so as to facilitate pupils' understanding and retention. To maintain quality control on its activities, the council rely to a greater extent on science education experts from Nigeria Universities, STAN,

research institutes who serve as resources persons in the development of science curriculum and instructional materials. The council also participates in the in-service training of science teachers. For instance, the Council developed training manuals and improvisation guides for the National primary science and mathematics project which were used to train the master trainers in all the states of the Federation.

SELF ASSESSMENT EXERCISE 2

List the bodies that assist the NERDC in ensuring high quality of its activities.

4.0 CONCLUSION

This unit has explained the roles played by WAEC and NERDC in reformation of science education curriculum in Nigeria. Some of the innovative projects carried out by the two bodies are also examined.

5.0 SUMMARY

This unit, has explained how WAEC was formed and some efforts so far made by the body in certification and science education development. The unit also mentioned the four curriculum development bodies that merged together to form NERDC, its functions, curriculum activities and lists of the textbooks published.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss how WAEC and NERDC can support Nigeria to make a breakthrough in technological development.
2. Discuss how you will tackle the problems of under-achievement and decline in enrolment in science subjects at both secondary and tertiary levels.

7.0 REFERENCES/FURTHER READINGS

Bajah, S. T. (1985). "New Dimensions in Science Curriculum Development Strategy in Nigeria. A Tripatite Approach. *JORIC Special* No. 1.

Ogunleye, A. O (1999). *Science Education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

MODULE 2

UNIT 1 PRIMARY SCIENCE CURRICULUM PROJECTS IN NIGERIA I

CONTENTS

1.0 INTRODUCTION

The unit will examine the trends in primary science curriculum projects in Nigeria from 1963 to 1968. As a science education learner, you need to have a good knowledge of what is in this unit. As it will give you the opportunity to know all the changes that have taken place in primary science curriculum in Nigeria. Therefore, you will be exposed to the following primary science curriculum projects:

- University of Nigeria Primary Science Pilot Scheme 1963
- African Primary Science Programme (APSP) 1965
- Bendel State of Nigeria Primary Science Programme (BPSP) 1968

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- identify the key individuals and organisations (local and foreign) that took active part in the development of each of the programmes
- state the objectives of each of the programmes
- list the printed materials produced for each of the programmes
- describe the evaluation procedures used for the assessment of the programmes
- mention the problems faced by the programmes during implementation of the projects.

3.0 MAIN CONTENT

3.1 University of Nigeria Primary Science Pilot Scheme, 1963

This began at the University of Nigeria, Nsukka in the Eastern part of Nigeria as a pilot scheme. The scheme was jointly sponsored by the Faculty of Education, University of Nigeria, Nsukka and the Ford Foundation.

The project came into being through Professor Babatunde Fafunwa. He got the inspiration through the Endicott House Conference of 1961 held in Debham, Massachaussetts USA. The conference was on the need for science in new nations.

He used his office as the Dean of Faculty of Education, University of Nigeria, Nsukka, in collaboration with other interested groups to organise series of workshops at Nsukka. He also made use of the services of Mike Savage who had worked on the Elementary Science Study (ESS) at Educational Services Incorporated (ESI) later known as Educational Development Centre (EDS).

The focus of the project was on local materials and improvised equipment such as the use of jam-jars, bamboo microscope and bamboo cages, etc.

The project placed emphasis on pupils' practical activities for eighteen (18) months, Savage tried out ideas and materials on elementary science in the rural environment of Awo-Omama. Thus, this project served as the first Primary Science curriculum project in Nigeria.

SELF ASSESSMENT EXERCISE 1

What is improvisation in the context of science?

3.2 African Primary Science Programme (APSP), 1965

This is one of the three major projects in Africa sponsored by EDC (former ESI) of Newton in USA.

The project was a regional programme initiated in Kano in 1965 at a conference involving fourteen African countries including Nigeria.

Organisational Support

The programnme was supported both materially and financially by:

- EDC
- Ford Foundation and
- United State of America

Purpose

The purpose of the project was to create in the children, the spirit of inquiry, a sense of curiosity and to develop in them the skills, techniques, and mental attitudes to satisfy the inquiry spirit.

Objectives of the Project

There was no detailed statement of objectives at the initial stage of the project. There were only phrases to indicate what they were doing. But Yoloye (1967), after evaluating the project since 2 years of its inception, came out with the following objectives:

- First – hand familiarity with the material world both natural and man-made.
- Interest in further exploration of the world around them on their own initiatives
- Ability to find out for themselves to see problems and to be able to set about resolving them for themselves
- Confidence in their own ability to find out for themselves and do things for themselves
- Ability to share in a common development of knowledge through collaborating on problems, telling, listening and discriminating use of second-hand sources.

SELF ASSESSMENT EXERCISE 2

State the purpose of APSP.

Activities and Materials Produced

About 25,000 copies of printed materials consisting of pupils books and teachers' guide covering over 30 topics were sent to Nigeria from APSP headquarters in Accra from 1965 to 1970.

These printed materials and educational films were distributed to teachers mostly in Lagos schools. The teachers' guide was in booklet form. It was divided into 2 sections. Book 1 was for the lower primary classes, and Book 2 was for the upper primary classes. There was also the "child observation checklist" which was used to evaluate child learning. However, the teachers found it difficult to identify the learning experiences the units were supposed to be providing.

SELF ASSESSMENT EXERCISE 3

What is the name of the printed material published by APSP headquarters for evaluating child learning?

Evaluation

The evaluation headed by Professor Yoloye touched on many aspects of the programme such as:

- Objectives
- Contents
- Materials used
- In-service and pre-service training of teachers
- Some outcomes of the programme on the children.

The performances of the experimental classes were compared with those in the non-experimental classes to evaluate the standard of the project. The APSP was not popular in most primary schools in Nigeria except with a very small number of schools around Lagos and Ibadan. The project was terminated due to financial constraints. All its materials were thus transferred to Science Education programmes for Africa (SEPA) which began in 1971.

SELF ASSESSMENT EXERCISE 4

Mention the problems faced by APSP during its implementation.

3.3 Bendel State of Nigeria Primary Science Programme (BPSP) 1968

This programme (BPSP) was developed between 1968 and 1969. It was first called Mid-Western State Primary Science Project and later it became known as the Bendel State Primary Science Project.

The project was directed by the State Ministry of Education. It was jointly sponsored by the UNESCO/UNICEF and the Government of the former Mid-Western State of Nigeria.

Purpose

The project based its general purpose on development of primary science curriculum and the training of teachers to teach primary science.

Objectives

The objectives were:

- To ensure the learning of science by all the primary school pupils throughout their primary school years.
- To ensure the adequacy of trained science teachers in all the primary schools.
- Development of the following in the child:

    1. the habit of keen observation
    2. the attitude of inquiry
    3. the habit of exploring, experimenting, and the recording of
    4. dates
    5. the basic concept of cause and effect
    6. the appreciation of the usefulness of the group work.

In essence, the project was designed to be child-centered. And it aimed at developing in the child, the mind of inquiry, self confidence, and self – reliance through problem solving.

SELF ASSESSMENT EXERCISE 5

List the sponsors of BPSP.

Materials Produced and Activities

The materials produced include the following:

- Pupils' book titled "Science is Discovering" published by Longman Nigeria (1972 – 1976) for classes one to four.
- Teachers Guide for each class.
- Primary school science syllabus for classes one to six
- Evaluation for Innovation – A handbook for science teachers. Items mentioned above were published by Science Curriculum Development Centre, Abraka.

Approach of the Content Materials

The syllabus contained nine units. It was treated in each of the classes one to six (I - IV). It was to be concentric or spiral in form as follows:

1. Animal life
2. Plant life
3. Our health
4. Safety measures
5. Our universe
6. Measurement
7. Air, water and weather
8. Rocks, soils and minerals
9. Materials around us

Each unit was to be treated conceptually through the basic process skills of observation, experimenting, recording of data etc.

Further to the materials produced, attempts were made to enhance the success of the project. Such attempts include the following:-

- Introduction of science in grade 2 teachers training colleges where duration was increased from 4 to 5 years and science was made compulsory for every prospective teacher.
- Establishment of the Science Curriculum Development Centre.
- Establishment of a permanent in-service training centre
- Excellent laboratories for all science subjects were built, furnished, and equipped in the year 1972 to 1974 in all teacher training colleges.
- A Continuing Education Centre (CEC) was established in 1972 in Benin City to cater for students who failed the West African School Certificate Examination (WASCE) and the Higher School Certificate Examination (HSC).
- A vacation course for chemistry teachers was organised in 1974 with the co-operation of University of Ibadan, Ibadan.
- Two thousand (2,000) teachers were produced between 1973 to 1974.

SELF ASSESSMENT EXERCISE 6

Name the approach used in writing the BPSP content materials

Evaluation

UNICEF requested for the evaluation of this project through International Centre for Educational Evaluation (ICEE) University of Ibadan, Ibadan in 1976. Dr. Wole Falayajo (now Professor) Dr. Tunde Bajah (now Professor) and Professor Yoloye formed the team of evaluators for the project.

Some of the points raised in the evaluation report are that:

- The printing of the pupils book for primary five was delayed by the printers for two years.
- The books were not evenly distributed to all schools to the extent that some schools in the divisional areas did not get a single book.

However, the implementation of the project was to a large extent a successful one.

SELF ASSESSMENT EXERCISE 7

List the names of the team that evaluated BPSP as requested by UNICEF.

4.0 CONCLUSION

This unit has dealt with three primary science curriculum projects in Nigeria namely: University of Nigeria Primary Science Pilot Scheme, 1963; African Primary Science Programme (APSP) 1965 and Bendel State of Nigeria Primary Science Programme (BPSP) 1968.

5.0 SUMMARY

This unit has discussed the sponsors, the purposes, objectives, activities of the projects and materials produced for each the project. The primary science curriculum projects in Nigeria are continued in the next unit 9

6.0 TUTOR-MARKED ASSIGNMENT

1. In a tabular form write out the names of individuals and organisations that took active part in each of the three primary science curriculum projects.

2. To what extent did the three projects achieve their purposes and objectives.
3. What would you consider as the constraints to the successful implementation of their projects in Nigeria.

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science Education in Nigeria*. Historical *Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

Omolewa, M. (1977). "Some Earliest Problems of Science Education in Nigeria" (1932 – 1959). *JSTAN*, 15 (3), 72 – 92.

UNIT 2 PRIMARY SCIENCE CURRICULUM PROJECTS IN NIGERIA II

CONTENTS

1.0 INTRODUCTION

In Unit 8 of this module, you studied three primary science curriculum projects in Nigeria. In this unit, you are going to study another two of these projects. While you are reading the unit, try as much as possible to link it up with the previous unit.

In this unit, you will study the following aspects of primary science curriculum projects in Nigeria:

- "Sayensi" – Ife Six Year Yoruba Language Primary Science Programme 1969
- ThePrimary Education Improvement Programme (PEIP), 1970

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- identify the key individuals and organisations (local and foreign) that participated in the development of each of the programmes
- state the purpose and objectives of each of the programmes
- list the printed materials produced for each of the programmes
- describe the evaluation procedures used for the assessment of the programmes
- identify those who designed the projects
- mention the problems faced by the programmes during implementation of the projects.

3.0 MAIN CONTENT

3.1 "Sayensi" – Ife Six Year Yoruba Language Primary Science Programme 1969

This programme was located at University of Ife, Ile-Ife now known as Obafemi Awolowo University, Ile-Ife. It was started in 1969 and it was the first and only indigenous experimental programme of its kind in this country. The programme made use of the mother tongue – Yoruba - as the medium of instruction.

It was first directed by Professor Babatunde Fafunwa of the Institute of Education of the then University of Ife. It was taken over by the Institute of Education after the retirement of Professor Fafunwa.

The project was supported by the University of Ife, Ford Foundation and Carnegie Cooperation. Later the running of the programme was taken over by the Oyo State Ministry of Education.

Purpose

The main purpose was the teaching and learning of science in Yoruba. It was the belief that it was easier to teach children in the language they understand and speak very well. The belief was also that better understanding could be generated by the use of a local language. Names of objects would appear familiar and meaningful.

Objectives

According to Babs Fafunwa (1979), the main objective of the project was:

To develop a primary education for the child and make him an intelligent citizen of his country.

From the main objective, other specific objectives were developed namely:

- To develop a primary school curriculum that is relevant and useful both to the child whose formal education terminates in primary six and the child whose education continues thereafter.
- Design materials with appropriate methodology for teaching the proposed curriculum effectively.
- Employ Yoruba language as the medium of instruction on the assumption that the child will benefit cognitively, socially, culturally and linguistically through the use of his mother tongue as the

language of instruction throughout the primary school and thus
bridge the gap between the home and school.

- Teach English language effectively as a foreign language through specially trained teachers throughout the six years and
- Evaluate the project continually with a view determining the presence or absence of certain significant differences between the project children and those of primary schools not connected with the project.

Professor R. O Alabi in his article titled "Teaching and Learning Science in the Yoruba Language" (1976) enumerated the advantages of using the mother tongue to teach science as:

1. Overcoming limited knowledge of foreign scientific vocabulary
2. Bringing closer to the children scientific examples and concepts
3. Developing a scientific store of vocabulary in the mother tongue
4. Helping adults who are not literate in English to understand and appreciate science.

Design of the Project

The overall design of the project includes the following:

- Approval was sought from the then Western State Ministry of Education for the selection of a typical primary school in Ile-Ife to be used for the experiment with 2 arms of experimental classes and the third arm as control.
- Establishment of a steering committee to work with the primary school in-service training for teachers, implementation of new methods and materials and the supervision of the project.
- University lecturers in languages and related subjects and professors from Ibadan, Ife and Lagos, principals of teacher training colleges, some primary and secondary school teachers in the old Western State, formed members of the Advisory Committee for the project.
- Curriculum writing teams for each subject were organised to comprise university teachers, primary school headmasters and secondary school and teachers colleges principals. The following subjects were touched:

- Science - *Sayensi*
- Mathematics – *Matimatiki*
- Social and Cultural Studies
- English Language
- Yoruba Language

SELF ASSESSMENT EXERCISE 1

What are the merits of using the mother tongue to each science?

Curriculum Development

Four workshops were conducted between 1970 and 1973, for a period of three to four weeks in each summer. The writing group was made up of thirty members.
The groups were divided into five panels, one panel for each of the five subjects. Their functions were to examine the existing curriculum, design a more appropriate one, and produce the necessary materials for teachers and pupils.

Science Panel

The Science Panel adapted the Science Education Programme for Africa (SEPA) and the Nigerian Primary Science Programme (BPSP) which were developed specifically for African children between 1964 and 1970.

Materials Produced

The materials produced include:

- Textbooks – "Sayensi" for primary classes (I – IV). Both the teachers' guide and pupils books were produced.
- Teachers' manuals.

Problems Encountered with the Project

- The absence of the equivalence of some scientific terms such as sodium, iron, lead etc.
- Finding commonly acceptable words from a possible list of varying dialets.
- Coining local language e.g. fridge "fifigi".
- The problem of proceeding to higher institutions of learning, where no such programme may be provided for.
- Mobility of the local labour produced was restricted.

Evaluation

Continuous assessment was used in evaluating the first phase of "Sayensi". The assessment was on weekly basis of short tests, and end of term or sessional examination. The materials for the tests were compiled and written by the authors of the text books.

The project on science teaching was once terminated due to some unavoidable circumstances but there was an announcement on its continuation by the Oyo State Government in 1986. The use of Yoruba for instruction of science was for primary classes 1 and 2 while English was to follow later. This was also been terminated.

SELF ASSESSMENT EXERCISE 2

State three problems faced by the implementation of this project.

3.2 The Primary Education Improvement Programme (PEIP) 1970

This was launched in 1970. It was a primary school curriculum. It was an innovation for the then six Northern States of Nigeria (now 19 states).

It was based in the Institute of Education, Ahmadu Bello University, Zaria.

The Programme was jointly sponsored by the then six (6) Northern States, UNICEF and UNESCO. The project was formerly called UNICEF/UNESCO assisted project but later called PEIP Primary Education Improvement Programme.

Purpose

The general purpose of PEIP was:

- To raise the standard of education in primary schools and to make primary education more relevant to the aspirations and expectations of the society.
- To establish a type of education that would ensure the development of youths into useful citizens in urban and rural settings of these states even if they failed to go beyond the primary level of formal school education.

SELF ASSESSMENT EXERCISE 3

What was the initial name of this project?

Objectives

According to Kolawole (1976) there were five major objectives of the programme vis:

- To develop a curriculum that is more modern in its approach.
- To create a curriculum that is for Nigerians in Nigeria, suitable for life in towns and in rural areas.
- To develop children as individuals imparting self discipline, basic skills, and strengthening literacy.
- To encourage utilisation of the environment.
- To accept that primary education for some 90% of the children is terminal and establish an education that will see to their development as useful citizens in towns or countries.

The above stated objectives form the major objectives for all the subjects developed by PEIP.

Science curriculum objectives were considered and according to Kolawole (1976) and Lassa (1977) were to enable the Nigeria child to:

- Observe and explore his environment.
- Develop basic scientific skills and processes;
- Develop functional knowledge of science concepts and science principles
- Develop scientific attitudes, for example curiosity, critical reflection, objectivity etc
- Explain, or account for simple natural phenomenon in the light of science
- Apply those skills and knowledge gained from science to solve every day problems in this environment, and
- Develop self-confidence and self-reliance through problem solving activities in science.

The above stated specific objectives centered on developing in the pupils the spirit of inquiry and scientific approach to issues.

SELF ASSESSMENT EXERCISE 4

State three main objectives of PEIP.

Materials Produced

Materials produced for science include:

1. Primary Science for Primary Classes 1 – 6
2. Pupils Workbook
3. Teachers' Guide

The books were printed by Longman Nigeria Plc.

The lower classes (1 and 2) had a section titled "In Creative Activities" while this section was taken up by "follow up activities" in the texts for classes 3 -6.

Books 1 and 2 had each section being set aside for science games and projects ranging from games with air/wind, shadows, identification of objects by sound produced, to the making of colourful soap bubbles.

This was to make science interesting to both pupils and teachers.

There were work sheets for answering questions and recording of findings, completing of tables, calculations, labellings etc in the classes 3 - 6 work- books.

Writing of the Text

Subject area panels for the curriculum writing exercise were organised.

They comprised the members of the Institute of Education Board of Studies. The editing of the work of each panel was done by the Institute's subject area specialist.

Organisation of the Project

The programme was time-tabled for six years (1970 – 1976) with two major phases, the pilot phase and the expansion phase.

The pilot phase was for 4 years 1970 – 1974, and the expansion phase from 1974 – 1978. About 800 primary school children were selected for the experiment.

There were co-ordinators for various agencies e.g. mobile teacher trainers in states, subject specialists, and co-ordinators of the programme at the Institute of Education. Mobile teacher trainers organised regular workshops and training of teachers. Dissemination of new ideas and materials was through mobile teachers in workshops and conferences.

Evaluation

Peter N. Lassa (1977) and Peter Asun (1982) evaluated the project on the following areas:

- the effect of the programme on participating tutors and teachers,
- the value of the mobile teaching force
- reactions of parents to the programme
- statistical data which could be found in respect of children and staff attendance at courses.

Both formative and summative evaluations were carried out. The summative evaluation came out with the following constraints to PEIP.

- No suitable model to go by, thus creating several mistakes in planning and administration with the curriculum being forced to adopt trial and error approach.
- Lack of enough staff, both junior and intermediate and no adequate publication facilities.
- Vast distances in areas to be covered prevented the MTT to visit PEIP school frequently.
- There were sixty-six (66) schools with only one or two specialists per subject thus there was no adequate follow up of their materials
- Prevailing conditions in schools such as:

- Stealing of PEIP materials
- Lack of desks or tables to organise lessons as ideally planned
- Destruction of PEIP materials due to non-replacement
- Transfer of PEIP teachers from their schools without replacement.
- Lack of incentives for PEIP teachers
- Change in government policies like change in calendar year from January to December, to October to June brought about over-lapping in the case of text-books for each class.

However, all comments about PEIP both subjective and empirical showed that the project has helped the children to develop cognitively and affectively.

SELF ASSESSMENT EXERCISE 5

Identify four constraints to PEIP implementation in a school setting.

4.0 CONCLUSION

In this unit, you have learnt two primary science curriculum projects in Nigeria namely the "Sayensi" – Ife Six Year Yoruba Language Primary Science Programme 1969 and the Primary Education Improvement Programme (PEIP) 1970.

5.0 SUMMARY

This unit has discussed the purposes, objectives, and organisation of the two projects as well as the text materials produced, problems encountered and evaluation of the projects. The remaining primary science curriculum projects in Nigeria are continued in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

1. Justify the use of the mother tongue as the medium of instruction in science teaching/learning in all levels of our educational system in Nigeria.
2. Describe the efforts of the present 19 states government of the Northern Region in development of science education at the primary school level.

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science Education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

Omolewa, M. (1977). "Some Earliest Problems of Science Education in Nigeria (1932 – 1959)". *JSTAN* , 15 (3), 72 – 92.

UNIT 3 PRIMARY SCIENCE CURRICULUM PROJECTS IN NIGERIA III

CONTENTS

1.0 INTRODUCTION

This unit further continues with the primary science curriculum projects in Nigeria. It will focus on another two of the projects, namely:

Ondo State Primary Science Programme (OSPSP), 1974
Core-curriculum, 1980

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- identify the key individuals and organisation (local and foreign) that actively participated in the development of each project
- state the purpose and objectives of each project
- identify those that organised the projects
- list the printed materials produced for each programme
- describe the evaluation proceeding used for the assessment of the programmes
- mention the problems encountered during implementation of the projects.

3.0 MAIN CONTENT

3.1 Ondo State Primary Science Programme (OSPSP), 1974

Ondo State Primary Science Project derived its existence from that of the former Western State which was launched in 1974.

It was formerly sponsored by former Western State government before the creation of states in 1976. The programme later continued in Ondo State after the creation of states.

Purpose

The Western State Primary Science Programme drew its inspiration from the outcome of the APSP workshop. The main purpose for the project was to produce a child-centered curriculum with an investigative approach.

Objectives

The objectives of the programme were:

- To develop the habit of keen observation.
- To develop the attitude of inquiry

The panel was charged with the responsibility of surveying the previous primary science curriculum on the following terms of reference:

- To examine closely the objectives of various primary science curricula with a view to identifying the common or core elements among them.
- To observe whether or not the core elements are consistent with the objectives for primary science curriculum stipulated in the National Policy on Education.
- To find out how much of the content of each state programme actually reflects the core-elements; and
- To identify the essential science equipment that would be needed to teach the core-content effectively in our primary schools and thus recommend the following:

- equipment that could be improvised by the teacher
- equipment that have to be manufactured locally.

After proper examination of the objectives of science teaching in eight of the syllabuses or programmes that were currently in use in Nigeria, the panel came with the following general objectives for science teaching in Nigeria within the context of the National Policy on Education.

Given the opportunity to manipulate and experiment with suitable equipment and materials, in a situation encouraging social interaction; science education should enable the Nigeria child to:

- observe and explore the environment
- develop basic science process skills, including observing, manipulating, classifying, communicating, inferring, hypothesising, interpreting data, and formulating models.
- develop a functional knowledge of science concepts and principles
- explain simple natural phenomena
- develop scientific attitude, including curiosity, critical reflection and objectivity.
- apply the skills and knowledge gained through science to solving everyday problems in his environment.
- develop self confidence and self reliance through problem solving activities in science.
- develop a functional awareness of and sensitivity to the orderliness and beauty in nature.
- develop the habit of exploring, experimenting and recording data.
- learn how to classify
- develop the idea of cause and effect.

SELF ASSESSMENT EXERCISE 1

Mention five general objectives for science teaching as stated in NPE.

Organisation and Activities

A panel consisting of university lecturers, practising teachers and inspectors of education was set up by the then Western State Ministry of Education to produce a primary science curriculum.

The programme was on experimental basis of 96 pilot schools from Akure Zone. The zone comprised many schools in Ondo State.

Development of science education was the sole responsibility of the Science and Mathematics Division of the State Ministry of Education. There were units to cater for different aspects of the developmental processes within the division.

The various units performed the following functions:

- Organisation of induction and in-service courses for practicing primary science teachers, and inspectors of education
- Supervising the teaching of the programme and distribution of materials to schools through the Zonal and Area Education Offices.
- Co-ordination of reports emanating from various schools and the Education Offices.

SELF ASSESSMENT EXERCISE 2

List the groups involved in the production of the science curriculum for OSPSP.

Materials produced

Pupils' books and teachers' guide were produced. The teachers guide was not completed for all the classes before the creation of states in 1976, but the programme continued in Ondo State.

Curriculum

The syllabus consisted of several topics, spread over six years and in ascending order of difficulty. Thus, as the pupil's ability developed, the demands made on them increased.

In the first three years, the pupil's thought was closely linked with his environment. He was guided to collect materials and to observe.

Understanding of measurement, sizes, shapes and simple relationships were developed. Handling, recognition, identification and classification of common objects and events were developed.

There was a teacher's guide for each class. The guide contained the topic to be taught, the mode of presentation and materials required.

Evaluation

Formative evaluation was carried out, but as at 1982, no summative evaluation was done because the programme was then still at the trial stage. The summative evaluation was proposed to take place after all primary schools must have had the opportunity of trying out the programme in all the classes.

By 1979, primary schools in Ondo State were handed over to Ministry of Local Government and Community Development. The supervision was inadequate, due to an acute shortage of qualified science inspectors.

SELF ASSESSMENT EXERCISE 3

State the features contained in the curriculum for the first three years on which the OSPSP materials were based.

3.2 Core – Curriculum 1980

The core-curriculum for primary science education was a modification of the primary science curriculum presented to the Joint Consultative Committee on Education (J.C.C.E).

The modification came about as a result of the conclusions reached at the Common Wealth Secretariat in London which organised seminars and workshops on the "Introduction of Low Cost Science Equipment" in Dar es Salam, Tanzania from September 20 – 30, 1977.

Some of the highlights of the conclusions of the seminars were that as follows:

- There is need for all countries to develop and align their science curriculum efforts to serve their needs in the context of their resources.
- All countries were requested to determine a core-content for their science curriculum. The ministry of Education in each country should then plan their equipment needed for the teaching of this core-curriculum, while leaving enough for the initiatives of school teachers to reflect their various environmental and financial situation and
- All countries should embark on the production of science equipment locally.

Members of the panel of the Joint Consultative Committee on Education were:

- Dr. B. C. E. Nwosu – Federal Ministry of Education – Chairman
- Dr. Kolawole – PEIP ABU. Zaria
- Mr. F. Agun – College of Education, Abraka
- Dr. I. Onyike – CUDIMAC University of Nigeria Nsukka
- Representative of NERC
- Representative of Ife Yoruba Project
- Dr. Oshiyale – Lagos State Primary Science Project
- One representative each from the following states:- Ondo, Lagos, Sokoto, Imo, Benue and Bauchi

The programmes examined were:

- Niger State Primary Science
- Lagos State Primary Science
- Anambra State Primary Science
- Oyo State Primary Science
- Ogun State Primary Science
- NERC Primary Science

- PEIP Primary Science
- Bendel State Abraka Project.

SELF ASSESSMENT EXERCISE 4

What is the theme of the seminar and workshop held in Dar es Salam, Tanzania 1977?

Materials Produced

A teachers' guide consisting of topics, performance objectives, content, activities, equipment and material to be used and evaluation questions on each topic.

The core contents are listed below:

Year One

- Exploring the environment: A nature discovery and walk around the school compound.
- Using the senses: seeing, hearing, touching, smelling and tasting
- Modelling with clay
- Simple properties of air
    - its existence
    - it occupies space
- Identifying and classifying objects by their properties
- Water
    - its uses
    - sinking and floating
    - playing with water
    - blowing – bubbles

Year Two

- Using the sense: Touch, taste, and smell
- Further activities with water
- Grouping by shape, size and colour
- Ordering of objects by comparing volumes, weights and lengths.
- Growing plants from seeds
- Air and wind; moving air from one container to another
- Making simple objects and figures using match boxes and clay
- Observing animals from the local environment.

SELF ASSESSMENT EXERCISE 5

List the contents of the Year One text material produced

Year Three

- Further activities on plants and animals: comparison of major characteristics e.g. seeding.
- Further activities on air and water
- Measurement – length (standard units)
    - comparing volume, time and weight
- Simple activities with mirrors and images
- Making sound with different local materials e.g. paw-paw stalk.
- Colour – dyes from plant and soil.

Year Four

- Soil – types and constituents
- Gardening – growing better plants, growth and food
- Water cycle – evaporation and condensation
- Simple ideas on heat and temperature
- Weather – regular observation and recording
- Measurement in standard unit (metric) length in metre, centimeter volume in litre.
- Names of colours, different shades of the same colour, making rainbow, observing natural colours and changes.
- Food types and uses
- Observing changes: in animals, in plants; due to heating; due to rusting.
- Exploring the human body – bones, joints, muscles and movement.

SELF ASSESSMENT EXERCISE 6

List the contents in years three and four text materials that belong to the physical sciences.

Year Five

- Air
    - pressure
    - propulsion, glider, flight of birds and kites
    - burning

- Domestic farm animals
- Bulb and battery, ways of lighting bulbs
- Heat, energy and temperature
- Rocks – classification – constituents uses of rocks
- Soap and alkali

- My body at work:

- breathing system
- feeding system
- excretory system

- How life begins: simple activities on flowering plants.

Year Six

- Making our task easier – pulley, levers, friction etc
- Growing better crops (project essential)
- Simple ideas about magnetism
- Our earth and sky
- Minerals – uses
- Us and where we live: changes caused by man in his environment, rubbish, its problem, disposal of rubbish, things which burn and things which can't, turning plant rubbish into compost, smoke and changes on burning something, oil smoke, the danger of using water to put out oil fire, the nature of smoke, harmful effects of smoke and cigarette smoking.

SELF ASSESSMENT EXERCISE 7

Identify the contents that belong to biological sciences in the years five & six contents.

Participants that Modified the Core-Curriculum

- Mr. T. A. Fasuyi - Federal Ministry of Education, Lagos
- Dr. B. C. Nwosu - Federal Ministry of Education, Lagos
- Mr. M. S. Momodu - Muslim Teachers Training College, Surulere, Lagos
- Dr. P. C. Medel - Faculty of Education, University of Benin, Benin-City
- Mr. A. O. Abiodun - Ministry of Education. Lagos State
- Mrs. K. O. Igbokwe - NERC Surulere, Lagos
- Dr. T. O. Odunusi - Faculty of Education, University of Lagos
- Mr. O. A. Lad - Federal Ministry of Education, Lagos

Evaluation

The project was said to be a commendable document in that, apart from its synthetic origin, there was the inclusion of some desirable teaching

expectations with possible learning outcomes that were in consonance with the objectives of primary sciences as given in the National Policy on Education.

However, it was discovered by NERC Writing Committee that some topics that would have furthered the 71rganizatio of the objectives as well as improve scientific literacy and technological awareness in the young generation were not included primarily because the terms of reference of the drafting committee, namely, to survey existing primary science curricula and determine a core-content that is consistent with the objectives of primary school science, constituted a clear constraint to the indepth exploration of the issues.

The core-curriculum was still at its trial stage when it was terminated due to some anomalies found in it.

SELF ASSESSMENT EXERCISE 8

Briefly assess the core-curriculum project.

4.0 CONCLUSION

In this unit, you studied another two primary science curriculum projects in Nigeria namely Ondo State Primary Science Programme (OSPSP), 1974 and Core-curriculum, 1980.

5.0 SUMMARY

This unit has discussed the purpose, objectives, organization, materials produced for OSPSP as well as the curriculum and evaluation of the project. The unit also discussed how the core curriculum came into being in 1980, by listing the members of the panel used, text materials produced with the contents for Year one to Year six, members of the group that modified the core–curriculum and the assessment of the project.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss how the organization and activities of OSPSP can be of assistance to the present day science teacher development

2. In a tabular form, identify the contents in Year one to Year six of the materials produced in the core-curriculum project of 1980 into three categories: biological, physical and social sciences.

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

Omolewa, M. (1977). Some Earliest Problems of Science Education in Nigeria (1932 – 1959). *JSTAN*, 15 (3), 72 – 92.

UNIT 4 PRIMARY SCIENCE CURRICULUM PROJECTS IN NIGERIA IV

CONTENTS

1.0 INTRODUCTION

In units 1, 2, and 3, you studied the primary science curriculum projects in Nigeria. You must have learnt the purpose, objectives, organisation and activity, materials produced and assessment of these seven projects.

In this unit, you are going to study the last of the primary science curriculum projects in Nigeria, which is known as National Primary School Science Project (NPSSP), 1986.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- identify the organisation that actively participated in the birth of the project
- state the purpose and objectives of the project
- mention the philosophy of the project
- list the printed materials produced for the project
- describe how the project was assessed.

3.0 MAIN CONTENT

3.1 National Primary School Science Project (NPSSP) 1986

This is a teaching curriculum development from the Federal Ministry of Education Core-Curriculum for Primary Science in 1980.

The Director of the programme was the Federal Government of Nigeria through the Federal Ministry of Education and Nigeria Educational Research Council.

Purpose

This project was developed in order to rectify some inadequacies found in the core-curriculum. Thus, the general purpose of the project was to provide guidelines for meaningful action to make education in Nigeria a true instrument for the reconstruction of our society and to achieve the development of national capacities in support of nationalism, social, scientific, technological, and economic development.

SELF ASSESSMENT EXERCISE 1

What would you consider as the main purpose of NPSSP?

Objectives

The aims and objectives of primary science education for Nigeria that are in consonance with the aims and objectives of primary education as stated in the National Policy on Education, are to:-

- Lay a solid foundation in science at the primary school level by introducing the basic processes of science to the children.
- Enable the Nigerian child develop spatial (three dimensional) perspectives in the course of his/her intellectual development.
- Provide opportunities for the Nigerian child to develop manipulative and psycho-motor skills through concrete experience;
- Develop the problem-solving skills of the Nigerian child to make him/her self-confident and self reliant, and
- Develop and sustain the interest of the Nigerian child in science through appreciation of orderliness and beauty in nature.

Philosophy

The NERC took cognisance of the need to make the Nigerian society scientifically literate and technologically oriented. This was encouraged by the unprecedented moral and material support of the Federal Government and thus developed the instructional materials "Aid to the teaching of Integrated Science in primary school".

The central theme chosen for the writing of the materials is "Science for Living" since it was strongly agreed by the writing panel that the survival needs of the Nigerian society were fundamental. Attempts were made to appeal to the child's natural characteristics, his curiosity and his love for asking questions.

To facilitate understanding, some topics and themes in the original curriculum were re-worded, modified or re-arranged in order to bring

down the topics to the conceptual level of the primary school child. New topics were added, such as Housing and Clothing and Relevant Technology.

All the topics, themes and concepts were spirally arranged to encourage reinforcement of knowledge, skills and attitude to facilitate retention and retrieval of knowledge and to stimulate interest and curiosity in the subject as well as provide opportunity for creativity.

SELF ASSESSMENT EXERCISE 2

What is the NPSSP all about in terms of its philosophy and arrangement of topics in materials written for the project?

Materials Produced

- A project newsletter and kits
- The syllabus and teaching materials
- Apparatus/equipment for teaching was distributed to all primary schools in the Federation.
- Text books

- Integrated Primary Science for Primary Schools
- Teachers' Guide
- National Primary Science and Mathematics Project – A
- training manual for primary science
- Teachers in Nigerian Schools Trial Edition – This was produced to teach prospective Grade II teachers or the NCE science teachers who were to teach science in primary schools.

SELF ASSESSMENT EXERCISE 3

List the text books produced for this project.

Teaching Approach

A combination of approaches was recommended for the teaching of the programme. Such methods were processes, conceptual, thematic or project approach, and the guided discovery approach which involves the activity of the child. This was made to over-ride (and indeed it ran through) the entire programme.

The format of the teachers' guide was structured explicitly into topics, sub-topics, key ideas, background knowledge, lesson objectives, time required, equipment and materials, pre-lesson preparation, outline of lesson, assessment of lesson and follow-up activities or home work.

SELF ASSESSMENT EXERCISE 4

List three approaches emphasised by NPSSP for the teaching of science.

Organisation and Activities

- There was no foreign hand involved
- The Federal Government was responsible for the whole cost of the project.
- The personnel, premises and materials needed for the execution of the project were provided by the Federal Government through the Federal Ministry of Education
- Supervision of the printing materials, traveling of writers to workshops, in-service training and course orientation workshop were done by the NERC.
- The NERC was to organise refresher courses for science teachers in order to up-grade the quality of teaching.
- The NERC was also responsible for the distribution of printed materials to each State Ministry of Education after collection from the Federal Government printers.

Efforts were made to train mobile teachers who would provide NERC with feed back from the field teachers on the use of materials produced.

SELF ASSESSMENT EXERCISE 5

State the role played by NERC in the making of this project.

Evaluation

The materials of the project were trial- tested in six selected primary schools in Zaria, Abeokuta, Port-Harcourt, Benin-City, Bauchi and Minna, in December 1982 and September 1983. Errors discovered during trial-testing stage were corrected.

However, there had not been any known summative evaluation of the programme and it was discovered that the few materials were in slim circulation in all states of the Federation and the impact was not properly felt.

During the past few years, efforts to improve science education in Nigeria have paid little attention to general education in science. The new projects are modeled after the Nuffield science (U.K) and the curriculum projects in the United States in the late 1950s and early 1960s. These courses in the two countries were developed to produce

scientists and engineers. In as much as they were improving the education of the science specialists and engineers by presenting science based on the structures of the individual disciplines and the processes of science, they failed to provide the low ability, average and non-science inclined students with basic general education in science. The integrated science which was designed to provide a general education in science in Nigeria (STAN, 1972) emphasises mainly the knowledge component of science with no reference to the social implications of science.

As earlier pointed out, science was introduced in the schools in Nigeria in the 1920s because it was felt that the "scientific worker must play a more prominent part in the creation and administration of the world of the future" (Education Policy, 1947), particularly in Nigeria where there was much ground to be made up in the fields of agriculture, health and industry. It was then thought that "schools should foster scientific though and method" (Education Policy, 1947). General science was to be taught for the careful introduction of nature. At the time of independence in 1960 several educators had expressed the need for science education in the schools if Nigeria was to develop. Elgood (1957) stated that if the nations of West Africa were to hold their own in the scientific age, it was imperative for them to evolve a system of secondary education that would enable the rising generation to have an adequate appreciation of scientific principles.

SELF ASSESSMENT EXERCISE 6

Why was science introduced in the schools in Nigeria in the 1920s?

4.0 CONCLUSION

This unit, has presented the National Primary School Science project.

5.0 SUMMARY

This unit, was presented discussed the purpose, objectives, philosophy and materials produced for National Primary School Science Project as well as the teaching approach, organisation and activity and evaluation of the project.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss the features of the guided discovery approach. How is it different from project approach?

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science Education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

Omolewa, M. (1977). Some Earliest Problems of Science Education in Nigeria (1932 – 1959). *JSTAN*, 15 (3), 72 – 93.

UNIT 5 SECONDARY SCIENCE CURRICULUM PROJECTS IN NIGERIA I

CONTENTS

1.0 INTRODUCTION

Curriculum innovations in science at the secondary school level came as a product of the joint efforts of STAN, WAEC, NERC and CESAC and the result of an urgent response to the new 3 – 3 system of secondary education. Efforts made in this direction resulted in the following science curriculum projects undertaken at the secondary school level and at different periods of time.

This unit will discuss two of these projects while the remaining two will be discuss in Unit 6. The two secondary science curriculum projects that you will learn in this unit are:

The Basic Science for Nigerian Secondary Schools (BSNSS) and the Nigerian Integrated Science Project (NISP)

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- name all the bodies that participated in making the BSNSS and NISP projects a reality
- state the objectives of BSNSS and NISP
- state the philosophy of the two projects
- list the bodies that provided financial support for the projects
- list the science materials produced for the projects
- state the procedure for evaluation of each of the projects.

3.0 MAIN CONTENT

3.1 The Basic Science for Nigerian Secondary Schools (BSNSS)

The BSNSS was the first science curriculum development project undertaken in Nigeria in 1963 to 1967 at the Comprehensive High School, Aiyetoro. Experts from Harvard University in the US gave useful advice on this project. The BSNSS was a curriculum in general science which covered the first two years of secondary school.

The Objective of BSNSS

To develop activity course in which the students would learn "science by doing".

Philosophy of the Project

The philosophy of the project was "Doing science the way scientists do it". That is observing carefully, reporting honestly what is observed and being patient. The programme is broken up into pupils' activities i.e. the pupils would actually do science and not learn about science. It is an attempt to shift the science from its dogmatic nature which is teachers' oriented nature. According to Skapski (1969), the approach was that:

- students should learn science by sciencing
- students experience in discovering facts themselves
- students should carry out processes as scientists do

Financial Support

The project was financed jointly by the following bodies:

- Western State Ministry of Education
- Science educators in the Graduate School of Education, Harvard University, US
- Prof. Fletcher Watson, he played a prominent role towards the development of the materials
- USAID – United State Agency for International Development
- Ford Foundation of America

According to Ogunnaike (1968), the basic science syllabus developed in Aiyetoro was written by Nigerians and was published in 1967 with the Teachers' Guide. The syllabus was conceived to be child-centred with emphasis on the discovery teaching method and with laboratory oriented activities. The underlying theme of the programme is "energy transfer" – how energy is acquired, supplied and transferred between living organisms and their surroundings.

SELF ASSESSMENT EXERCISE 1

Mention the features of the discovery teaching method.

Science Material Produced for BSNSS Project

The details of the contents of BSNSS were divided into two main blocks namely: Block 1 for Form 1 and Block II for Form II.

In block 1, there were five units, viz:

Unit 1 - Introduction to science
Unit II - Heat
Unit III - Mechanics
Unit IV - Electricity
Unit V - Chemistry

In block II, there were four units, viz:

Unit I - Small Organisms and cells
Unit II - Food and Nutrition
Unit III - Diseases
Unit IV - Ecology

Evaluation of the Project

The programme was not widely adopted in schools as it did not go beyond the pilot-testing stage. Reasons for this could have been that:

- the objectives of BSNSS may have been at variance with our traditional science curricula used in the schools throughout the federation at that time.
- the advent of integrated science syllabus world wide could be another factor against the BSNSS

SELF ASSESSMENT EXERCISE 2

Mention the only success that can be attributed to BSNSS project in spite of its set back.

3.2 The Nigerian Integrated Science Project (NISP)

The NISP was the first science curriculum project developed by the STAN in 1970. The Integrated Science Project comprised disciplines drawn from biology, chemistry, physics and the earth sciences. The Project was written in conformity with the guidelines as specified in

STAN's Curriculum Development Newsletter No. 1 which contained the philosophy, methodology, content and evaluation of integrated science. The newsletter listed some of the skills students would acquire after having been exposed to a course in integrated science as thus:

- Observing
- Measuring
- Classifying
- Reporting
- Organising
- Generalising
- Predicting
- Experimenting

STAN commissioned its members to write the pupils' text book and teachers guide for the NISP.

The philosophy of the integration was designed to help the child to:

- gain the concept of the fundamental unit of science
- gain the commonality of approach to problems of a scientific nature
- gain an understanding of the role and function of science in everyday life and the world in which he/she lives.

SELF ASSESSMENT EXERCISE 3

List the processes of science

Financial Support

The project was financed with support from generous philanthropists and foreign bodies such as the following:

- Late Adam Skapski whose support was received from the Ford Foundation through CESAC
- Chief H. M. B Somade through CESAC
- The Curriculum Renewal & Educational Development Overseas (CREDO), through British Council in Nigeria
- Support received inform of Curriculum materials from UNESCO and from a publishing company i.e. Longman Nig. Ltd.

According to Ogunleye (1999) the approach used in NISP was the child-centred approach which was basically activity-oriented.

Science Materials Produced for NISP Project

- Pupils' Textbooks I & II
- Pupils' Workbooks I & II
- Teachers' Guide

The pupils' textbooks consisted of contents subdivided into Years I and II. The content was divided into units with chapters. Each unit had an introduction and objectives to achieve at the end. Year I textbook consisted of 6 units with 17 chapters while Year II consisted of 6 units with 19 chapters.

The content of NISP revolved around the 6 themes given below

Unit 1 - You as a living thing
Unit 2 - You and your home
Unit 3 - Living components of the environment
Unit 4 - Non-living components of the environment
Unit 5 - Saving your energy
Unit 6 - Controlling the environment

Evaluation of the project

This was made in line with the philosophy of the project

- **Readability**: Studies conducted by Soyibo (1979) and Jegede (1982) revealed that the readability indices of NISP texts were low (i.e. not highly readable). To solve this problem, the long style used in writing the text should be simplified in future to enhance proper pupils' comprehension.

- **Difficulty of the Topics**: Difficulty was contingent on the language level, cognitive demand and instructional methodology of the science curriculum (Bomide, 1983).

- **Teaching Facilities**: Studies conducted on NISP by Bankefa (1978), Odubunmi (1981) and Igbalajobi (1982) revealed that most of the schools surveyed lacked adequate laboratory apparatus for effective teaching and learning of integrated science. To solve this problem, teachers were advised to embark on extensive improvisation of materials.

SELF ASSESSMENT EXERCISE 5

Would you see the problem of the integrated science teachers' lack of understanding of the philosophy underlying the course as another factor against the success of the NISP?

4.0 CONCLUSION

This unit, has examined two secondary science curriculum projects namely: BSNSS and NISP. The BSNSS and NISP were the first and second science curriculum development projects undertaken in this country. Prior to the emergent of the BSNSS in Nigeria, the science syllabus was characterised by the topical approach in the structure of the content. Science was then presented as bits and pieces of information with no conceptual relationship.

5.0 SUMMARY

So far, you have studied the basic philosophy underlying the two science curriculum projects, the financiers, the materials produced to teach the projects and the evaluation of the projects.

6.0 TUTOR-MARKED ASSIGNMENT

How would you as a science teacher assess the two secondary science curriculum projects in the context of the present curriculum in Nigeria?

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science Education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

Ogunnaike, A. O. (1968). JSTAN, 7(1) *STAN* (1970). "Integrated Science. A course for the Junior Forms of Secondary Schools". *Curriculum Newsletter No 1, Ibadan: Yoruba Press.*

UNIT 6 SECONDARY SCIENCE CURRICULUM PROJECTS IN NIGERIA II

CONTENTS

1.0 INTRODUCTION

In the process of developing various science curricula, experts were of the opinion that relevance to the society, interest and ability of students should be taken into consideration. When the pioneer secondary science curriculum project, (BSNSS) and that of NISP could not meet the needs of the society which the schools served (Ivowi, 1978) other curriculum innovations in science at the secondary school level came into being. These are what this unit intends to discuss. They are:

The Nigerian Secondary Schools Science Project (NSSSP) and the National Science Curriculum for Senior Secondary Schools (NSCSSS)

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- name all the bodies that participated in NSSSP and NSCSSS
- state the objectives of the projects
- state the underlying philosophy of the projects
- list the financiers of the projects
- list the science materials produced to execute the project.

3.0 MAIN CONTENT

3.1 The Nigerian Secondary Schools Science Project (NSSSP)

The development of NSSSP started in 1970 by CESAC in biology, chemistry and physics as an alternative syllabus for forms III – V of secondary schools all over the federation.

Aims of NSSSP

NSSSP aimed at developing in students, conceptual thinking, manipulative skills and scientific attitudes.

The basic philosophy of NSSSP was the preparation of the young ones for useful living in the society and higher education through training in the use of both the brain and the hands.

Objectives of NSSSP

- To obtain a proper understanding of the basic concepts of science
- To develop scientific skills especially the manipulative ones
- To acquire the right attitudes such as honesty, tolerance, objectivity and cooperation

Financial Support

- First three years of formation funded by Late Dr. Adam Skapski through Ford Foundation
- The Federal Government of Nigeria through Federal Ministry of Education.

The NSSSP adopted the guided discovery method of teaching and the conceptual theme approach to content selection.

SELF ASSESSMENT EXERCISE 1

To what extent will you say the objectives of NSSSP have been achieved?

Science materials produced for NSSSP

For each of the science subjects biology, chemistry and physics, textual materials in the form of Books 1, 2 and 3 were developed for students together with Teacher Guides 1 – 3.

Evaluation of NSSSP

In the process of implementing NSSSP, various problems surfaced which are:

- Inadequate funding by the Government
- Lack of support from Ministry of Education officials and school administrations who readily agree with new plans but show no sign of readiness to put their support into practice

- Implementation problems
- Lack of infrastructures such as personnel, space, equipment for teaching service
- Lack of commitment on the part of teachers
- Unpreparedness of the teachers
- Lack of effectiveness in teaching due to teachers' ignorance of the philosophy and objectives of the project.
- Inadequate supply of materials, such as books.
- Over population of students in the classroom
- Social factors, such as some societies for bidding the teaching of some science concepts like sex, reproduction, birth control etc.

SELF ASSESSMENT EXERCISE 2

Discuss how the problem of unpreparedness of science teachers can affect the proper implementation of a curriculum.

3.2 The National Science Curriculum for Senior Secondary Schools (NSCSSS)

The National Science Curriculum came into being as a result of the National Workshop on Secondary Education Curriculum which was organised by the NERC whose report was submitted by 1978. This workshop enabled this country to have a basic philosophy for science teaching and a national science curriculum which is now used in all our junior and senior secondary schools throughout the Federation.

The Basic Philosophy of NSCSSS

- To enable the learner to utilise science for realisation, self-fulfillment and self-development
- To equip the youths of this country with such intellectual know how which will enable them to contribute significantly to the development of the country, particularly in the mobilisation of national manpower.
- To prepare the more able youths for higher education in science.

Characteristic Features of the NSCSSS

- The spiral or concentric approach to the teaching of concepts
- The use of the guided discovery method in teaching as a way of ensuring that learning as an activity takes place during exploration, experimentation and discussion.
- The arrangement of the contents in a logical, developmental and sequential order

- The identification of an array of performance objectives for each topic of the curriculum.
- The arrangement of the teaching syllabus into five sections viz:

- Topic
- Performance Objectives
- Content
- Activity
- Notes

SELF ASSESSMENT EXERCISE 3

Look for a science curriculum related to your area of specialisation. Write out the general objectives of that subject.

4.0 CONCLUSION

This unit has examined the details of the most two recent science curriculum innovative projects undertaken at the secondary school levels in Nigeria namely NSSSP and NSCSSS.

5.0 SUMMARY

One common feature of the projects treated in this unit is the desire to improve the effectiveness of practical and relevant science education for Nigerian secondary schools.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss what will be your own assessment of the NSCSSS.

7.0 REFERENCES/FURTHER READINGS

Ogunleye, A. O. (1999). *Science Education in Nigeria. Historical Development, Curriculum Reforms and Research.* Sunshine International Publications (Nig.) Ltd.

FME (1985) National Curriculum for Senior Secondary School, Vol. 3 – Science, Lagos.

UNIT 7 SCIENCE EDUCATION IN BRITAIN

CONTENTS

1.0 INTRODUCTION

The unit will examine the historical development of science education in Britain. The history will afford you the opportunity to have a good knowledge of the roles played by Science Masters Association (SMA) and Association for Women Science Teachers (AWST) as well as Nuffield Foundation in the development of science education in British schools.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- write a report of the development of science education in British schools
- discuss the roles played by Nuffield Foundation in British Modern Curriculum Projects
- list the contributions of the science associations to science education in Britain.

3.0 MAIN CONTENT

3.1 Development of Science Education in Britain

Science was first introduced into public schools before 1900. From there it extended to other state schools during the period between the two World Wars. The affairs of science were handled by science teachers who established about a century ago, the Science Masters Association (SMA). They developed schemes for science teaching in secondary schools in 1930, followed by the formation of Association for Women Science Teachers (AWST) which later merged with SMA to form Association for Science Education (ASE) in 1961. In Britain, the

academically oriented students were taught physics, chemistry and biology while the average students learnt general science. The academically inclined students took GCE in the separate sciences, while the others took Certificate of Secondary Education Examination (CSE).

During 1945 – 1960, the science syllabus became crowded so the Science Masters Association and the Association of Women Science Teachers established different subject committees in the 1950s. In 1951 – 1961, these associations published:

- Biology for Grammar Schools
- Chemistry for Grammar Schools
- Physics for Grammar Schools in London by John Murray Limited in 1961.

The Science Masters Association in 1965 also published School Science and General Education in Cambridge for all pupils in the first five (5) years of secondary education.

SELF ASSESSMENT EXERCISE 1

Identify the roles played by SMA in the development of science education in British Schools.

3.2 Modern Curriculum Projects

The syllabuses and policy statements published by SMA and AWST earlier were very important in British Science Education. However, when the teachers asked for financial support from the government to extend their work, there was no reply. Nuffield Foundation that is a British charitable educational foundation like Ford Foundation invested a lot of money in support of teachers in project work. Hence, Nuffield Science Schemes were launched in 1961 – 62. The original Nuffield Science Schemes was concerned with the production of new materials for biology, chemistry and physics at the GCE O' Level for children aged 11 – 16. The Nuffield Foundation also invested in A' Level GCE, and the Nuffield Combined science Project which was concerned with integrated science in the first two years of secondary education.

In 1964, the Government launched a Schools Council for Curriculum and Examinations which is a representative body of the Department of Education and Science (DES). The Council received grant from the Government and the LEAs. They carried out educational research and curriculum development in England and Wales.

The secondary school science curriculum projects had a common methodology which emphasises students' active involvement in laboratory and field experience. Teachers' guide, resource books and experimental guides were produced for students use.

SELF ASSESSMENT EXERCISE 2

Briefly discuss the contributions of Nuffield Foundation to Modern Curriculum Projects in Britain.

4.0 CONCLUSION

This unit, has explained the fact that science was first introduced into British public schools before 1900, later to the state schools, that SMA and AWST played major roles in the development of science education. That the efforts of the SMA and AWST were supported by Nuffield Foundation, which led to the launching of the Nuffield Science in 1961–62.

5.0 SUMMARY

This unit has discussed the development of science education in Britain. The topic continues in the next unit 1 under module 3 as British Science Curriculum Project I.

6.0 TUTOR-MARKED ASSIGNMENT

Compare the development of science education in Britain with that of Nigeria.

7.0 REFERENCES/FURTHER READINGS

Encyclopedia Britanica, Vol. XVI.

MODULE 3

UNIT 1 BRITISH SCIENCE CURRICULUM PROJECTS I

CONTENTS

1.0 INTRODUCTION

This unit is a continuation of Unit 14. It examines the emergence of Scottish integrated science in 1966 and highlights the various activities carried out towards improving science education in Scottish schools.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss the emergence of Scottish Integrated Science and science
- state the general objectives of the syllabus for the first two years in Scottish schools based on the three domains namely: knowledge, attitude and skills
- mention the teaching techniques recommended for Scottish Integrated Science
- state the aims of school council project technology
- list the text materials available for Scottish Integrated Science.

3.0 MAIN CONTENT

3.1 Scottish Integrated Science

This course is different from the most modern curriculum project. The 1964 Working Party was established to review the existing science curriculum for Scottish students in non-certificate courses and to consider the "Alternative Syllabus" to the lower – level courses. The working party was not established to produce materials for students or teachers' use. In 1966, in order to produce a homogenous academic platform for the early years of secondary schools, the working party carried out the following comprehensive review on present science curriculum in

- the first two years of secondary education;
- the later years of secondary education for non-academic pupils.

The working party, then prepared a workable syllabus which was evaluated in schools. The syllabus was for the first two years (Grades 8 & 9). The resulting approach is now known as Scottish Integrated Science. Work sheets were distributed during the period of trial-testing in schools, which were revised after evaluation and published. Text-books were later published following the order of the syllabus and associated teachers' guides.

SELF ASSESSMENT EXERCISE 1

Briefly discuss the roles played by the working party in the emergence of Scottish Integrated Science.

The Syllabus for the First Two Years

The first two years in Scottish schools emphasises the teaching of science which contributes a lot to general education. Students are exposed to experimental methods of scientists, the apparatus used and methods of drawing conclusion.

The stated general objectives of the syllabus are:

- In knowledge and understanding pupils should acquire:

- knowledge of some facts and concepts concerning the environment
- knowledge of the use of appropriate instruments in scientific experiments.
- adequate scientific vocabulary

- an ability to communicate using this vocabulary
- comprehension of some basic concepts in science so that they can be used in familiar situations.
- the ability to select relevant knowledge and apply it in new situations
- the ability to analyse data and draw conclusions
- the ability to think and act creativity in science

- In attitude:

- awareness of the inter-relationship of different disciplines of science
- awareness of the relationship of science to other aspects of the curriculum
- awareness of the contributions of science to the economic and social life of the community
- interest and enjoyment in science
- an objectivity in observation and in assessing observations.

- In practical skills

- some simple science-based skills
- some experimental techniques involving several skills

It was hoped that this syllabus would provide a means of educating students to 'O' level grade and beyond the Scottish Certificate of Education (SCE) examinations provided equivalent of chemistry and physics in integrated science form for those that will not be studying science anymore and at the same time it provided a link for those that would study advance science.

SELF ASSESSMENT EXERCISE 2

Explain the rationale behind this first two year syllabus in Scottish Integrated Science.

Recommended Teaching Techniques

The Scottish Integrated Science Course involved extensive laboratory work. Students were expected to work individually or in small groups. Teachers however, were expected to demonstrate the dangerous techniques to the students. In Scotland, science is treated as a "practical subject" with only 20 students in a class. The teachers were provided with experimental procedures from teachers in trial schools to improve and ease their work in form of memoranda for teachers. Ideas on demonstration to be performed by teachers were also provided in

bulletins of Scottish Schools Science Equipment Research Centre (SSSERC). This information also helped technicians to produce the new equipment required in schools in the work-shop.

SELF ASSESSMENT EXERCISE 3

List the teaching technique recommended for Scottish Integrated Science.

Materials available

Work sheets were produced for the pupils to use for the course but pupils were not to be left alone to work on the sheets without teachers.

Textbook and Teachers' Guides

The pupils texts and teachers guides were published in the 70's as the publication of Scottish Education Department and Consultative Committee on the Curriculum.

- Curriculum Papers 7. Science for General Education: For the first Two years and Early School Leavers. Edinburgh: Her Majesty's Stationary office, 1969.
- Scottish Education Department. "Science Topics for Third and Fourth Year Non – G. C. E. Courses". Mineographed.
- Scottish Secondary Science Working Party. Science Worksheets: Year 9 – 15. London: Heinemann Educational Books. 1969.

Working Party on Secondary Science

Integrated Science Courses: Memoranda for Teachers, Section 1 – 8 (Year 1). Revised Version. Edinburgh: Scottish Educational Department.

Integrated Science Course: Memoranda for Teachers, Sections 9 – 14 (Year II). Edinburgh, Scottish Education Department, Series.

SELF ASSESSMENT EXERCISE 4

Name the major textbooks published for Scottish Integrated Science Project.

4.0 CONCLUSION

This unit highlighted the activities of Scottish Integrated Science such as designing of syllabus for the first two years of secondary education in Scottish schools, recommendation of teaching techniques and production of both students' textbooks and teachers' guides on Integrated Science and science subjects.

5.0 SUMMARY

In 1964, a working party was established in Scottish purposely to review the existing science curricula for Scottish students in non-certificate courses. The outcome of which produced what is known as Scottish Integrated Science for the first two years (grades 8 – 9) in Scottish schools. In the next unit, you will study another British science curriculum projects.

6.0 TUTOR-MARKED ASSIGNMENT

Briefly explain how science is taught in Scotland.

7.0 REFERENCES/FURTHER READINGS

Encyclopedia Britanica, Vol XVI..

UNIT 2 BRITISH SCIENCE CURRICULUM PROJECTS II

CONTENTS

1.0 INTRODUCTION

This unit is a continuation of Unit 2. Here you are going to study another British science curriculum project called Nuffield Combined Science. The Nuffield Combined Science team was set up in 1966 to synthesis the science curriculum materials provided for the first two years of secondary education in Britain. The purpose of this unit is to discuss the activities involved in Nuffield Combined Science and Nuffield Secondary Science.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss the roles played by Nuffield Combined Science in British science curriculum
- list seven contents of the Nuffield Combined Science materials
- explain all the teaching techniques recommended by Combined Science
- list five materials produced by Nuffield combined science
- explain what Nuffield Secondary Science is in the British science curriculum
- discuss the aims and objectives of Nuffield Secondary Science
- explain pupils' activities under Nuffield Secondary Science
- identify eight text materials produced by Nuffield Secondary Science.

3.0 MAIN CONTENT

3.1 Nuffield Combined Science

The Nuffield Combined Science team was set up in 1966. Teachers were expected to exercise their professional judgments concerning details of content and order of the provided structured syllabus in producing a suitable teaching sequence. Hence, they had the task of synthesising the materials provided for children in the first two years of British secondary schools.

The content of the Nuffield combined science materials are:

- The work around us
- Looking for patterns
- How living things begins
- Air
- Electricity
- Water
- Small Things
- Earth
- Insects
- Energy

SELF ASSESSMENT EXERCISE 1

When was the Nuffield Combined Science team set up. What was the duty assigned to the team?

Recommended Teaching Techniques

In combined science, a very strong emphasis is laid on students first hand experience which is reflected in the laboratory experiments. The school authority gives student assignments which are expected to be done from home so that their friends and parents would know what they are being taught in school. The students are allowed to learn through the guided discovery method.

SELF ASSESSMENT EXERCISE 2

Name the teaching technique recommended by combined science.

Materials Produced

The materials produced are teachers' guide, activity books and film loops. The publications were all published jointly by Renguin and Longmans, 1970. They are:

- Nuffield Combined Science: Teachers' Guide I, Sections 1 – 15
- Nuffield Combined Science: Teachers' Guide II, Sections 6 – 10
- Nuffield Combined Science: Teachers' Guide III
- Nuffield Combined Science: Pack I Activities
- Nuffield Combined Science: Pack II Activities

SELF ASSESSMENT EXERCISE 3

Name the publishers of the Nuffield combined science

Current Work

A continuation was set up for the middle schools by the LEAs but no materials have been published to date.

3.2 Nuffield Secondary Science

The Nuffield Secondary Science is for the lower 75 Percent of the ability range of the population aged 13 – 16. Secondary science is based firmly on the principles of the Working Paper with its population extended to include all those unlikely to be taking 'O' Level General Certificate of Education examinations and those who probably would be taking 'O' Level Examinations in other subjects

SELF ASSESSMENT EXERCISE 4

What is the age bracket of the population which the Nuffield Secondary Science is meant for?

Aims

Secondary science attempts to provide opportunities to pupils to understand things of the scientific background and implications of economic, social and moral problems and to equip them for everyday life. They need to solve problems, to predict the consequences of actions and to evaluate assertions, of politicians, advertisers and scientists.

Objectives

The objectives in secondary science lessons are to provide immediate opportunity for and encouragement of accurate observation, deduction of, generalisation, inferences from concepts or generalisations, design of simple experiments and formation of hypothesis. This opportunity is taken to improve verbal fluency, literacy and numeracy, to encourage self-discipline and responsibility for organisation of work.

SELF ASSESSMENT EXERCISE 5

What are the opportunities derivable from secondary science?

Themes of Nuffield Secondary Science

Eight themes have been developed by the Working Paper for the secondary schools. The themes are:

- Interdependence of living things
- Continuity of life
- Biology of man
- Harnessing energy
- Extension of sense perception
- Movement
- Using materials
- The Earth and its place in the Universe

There should be pupils' experiments and teachers' demonstrations in each theme.

SELF ASSESSMENT EXERCISE 6

Categorise the eight themes into physical and biological issues.

Pupils' Activities

Students are expected to perform the experiments all by themselves. By so doing they learn a lot and even discover new things which are useful to them.

SELF ASSESSMENT EXERCISE 7

What name will you give to a curriculum that emphasises this type of pupils' activities?

Materials Produced

The following materials produced were published by Longmans, 1971:

- Nuffield Secondary Science, Theme 7 Using Materials by Blackledge, J. Carter, Derek and Milbourne, J. J
- Nuffield Secondary Science, Theme 3: Biology of Man by Fox, Denis
- Nuffield Secondary Science, Theme 4: Harnessing Energy by Howard, D.
- Nuffield Secondary Science, Theme 5: Extension of Sense Perception by Howard, Edgar.
- Nuffield Secondary Science, Theme 8: The Earth and its Place in the Universe by Leigh, R.
- Nuffield Secondary Science, Theme 1: Interdependence of Living Things by Marson, J. E.
- Nuffield Secondary Science: Examining at CSE Level
- Nuffield Secondary Science: Teachers' Guide
- Nuffield Secondary Science, Theme 6: Movement by Richards or, Wand Tollyfield, J. K.
- Nuffield Secondary Science: Apparatus Guide by Roberts, K. M.
- Nuffield Secondary Science: Theme 2: Continuity of Life by Wiggles Worth, G.
- Britains Fueld by Milbourn, J. J. and series of film loops photographs and slides.

SELF ASSESSMENT EXERCISE 8

List eight authors of text materials produced by Nuffield Secondary Science

4.0 CONCLUSION

This Unit has been able to expose you to some of the activities of Nuffield combined science and Nuffield secondary science which are both British Science Curriculum projects. It is my candid opinion that you, as a science educator would have been better equipped to compare these activities with any of Nigerian science Curriculum projects that you have been introduced to in this course.

5.0 SUMMARY

This unit discussed the development of science education curricula in Britain through Nuffield Combined Science and Nuffield Secondary Science. This topic is continued in Unit 17.

6.0 TUTOR-MARKED ASSIGNMENT

Differentiate extensively between Nuffield Combined Science and Nuffield Secondary Science.

7.0 REFERENCES/FURTHER READINGS

Encyclopedia Britanica, Vol. XVI.

UNIT 3 BRITISH SCIENCE CURRICULUM PROJECTS III

CONTENTS

I.0 INTRODUCTION

This is the last unit that discusses issues on British Science Curriculum Projects. It examines the Schools Council Integrated Science Project and the Nuffield Science Schemes, namely Nuffield Ordinary and Advanced Levels. It also examines the science programme designed for pupils of ages 5 and 13.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the purpose of the Schools Council Integrated Project (SCISP)
- explain the words Patterns Approach in the context of a curriculum
- identify at least five text materials published for each of the three science subjects (biology, chemistry and physics) at O' level
- discuss the science programme at 5 and 13 projects.

3.0 MAIN CONTENT

3.1 The Schools Council Integrated Science Project (SCISP)

The Schools Council Integrated Science Project was organised for student above average ability. This was to enable students perform better in GCE Examination. The primary aim of the project is to inculcate in pupils attitudes such as critical thinking and objective observation. SCISP emphasis intellectual work. Students were expected to be able to reason why a reaction occurs rather than just recording its occurrence.

In order to guide the development of materials for an integrated science course two existing models of science curricula were combined to produce "Patterns Approach". This combines "Process Approach" which is the processes involved in science with "Conceptual Approach" which aims to develop awareness and understanding of major concepts of science. This approach is based on building blocks, interaction and energy.

SELF ASSESSMENT EXERCISE 1

State the aim of SCISP? What do you understand by "Patterns Approach"?

3.1.1 Nuffield 'O' Level Science Scheme

The Nuffield 'O' Level Science Scheme was the very first to be initiated in 1962 in an attempt to reform school science education (Clark, 1972). The basic aim of the scheme was to foster a different attitude to science subjects in both students and teachers through active laboratory exercises (Gummett, 1980). The materials produced under the scheme are pupils' manuals, teachers' guides and technicians manuals published under the general heading "Patterns".

3.1.2 Nuffield 'O' Level Biology

This scheme is divided into five sections of each year's duration. The first two years being grades 7, 8. It's a three period teaching of 40 – 45 minutes each per week with a double period for practical exercises. The students are systematically introduced into biology with the later part requiring increasing depth of thinking at high levels of Blooms taxonomy.

For each year, there is a students' textbook and teachers' guide. In addition to these are 8mm film loops, a set of 8 slides on locust

development and 12 slides on pleurococcus and photographs of meiosis and mitosis

Materials Available for Nuffield 'O' Level Biology

- Nuffield Biology: Text 1:Introducing Living Things
- Nuffield Biology: Text 2:Life and Living Processes
- Nuffield Biology: Text 3:The Maintenance of Life
- Nuffield Biology: Text 4:Living things in Action
- Nuffield Biology: Text 5:The Perpetuation of Life
- Nuffield Biology Teachers' Guide 1
- Nuffield Biology Teachers' Guide 2
- Nuffield Biology Teachers' Guide 3
- Nuffield BiologyTeachers' Guide 4
- Nuffield Biology Teachers' Guide 5
- Nuffield Biology: Keys to Small Organisms in Soils, Litter and Water Troughs.

SELF ASSESSMENT EXERCISE 2

1. What is the basic aim of Nuffield 'O' Level Science Scheme?
2. List the three sets of materials produced for this scheme.
3. Identify two other instructional materials apart from text produced for the scheme in biology.

3.1.3 Nuffield 'A' Level Biology

The Nuffield 'A' Level Biological Science has four units each of 90 periods of 40 minutes of class work each period. The scheme includes:

- Maintenance of the organism
- Organisms and population
- The developing organisms
- Control and co-ordination in organisms

Materials available are Laboratory Guides and Teachers' Guide

SELF ASSESSMENT EXERCISE 3

Highlight the difference between the Nuffield 'O' Level and 'A' Level Biology.

3.1.4 Nuffield 'O' Level Chemistry

This scheme is divided into three stages. The first stage is taught in the first two years. It is a 40 – 45 minutes lesson as in biology. The materials available are sample schemes of stages 1, 2 and 3 and are produced in forms of:

- Hand-book for Teachers
- Introduction and Guide
- Laboratory Investigation Sheets
- Book of Data

Materials Available for 'O' Level Chemistry

- Nuffield Chemistry: Introduction and Guide
- Nuffield Chemistry: The sample scheme stages 1 and 2: The Basic Course
- Nuffield Chemistry: The sample scheme stage 3: A course of options
- Nuffield Chemistry: Collected Experiments
- Nuffield Chemistry: Handbook for Teachers
- Nuffield Chemistry: Laboratory Investigations Stage 1A, Stage 1B,Stage 2 and Stage 3 options.
- Nuffield Chemistry: Book of Data.

SELF ASSESSMENT EXERCISE 4

List the four forms in which Nuffield 'O' Level Chemistry text materials are produced.

3.1.5 Nuffield 'A' Level Chemistry

This scheme treats in detail inorganic and organic chemistry and some element of biochemistry. Publications including two Students' Books', Experiment Sheets, four programmed texts and the Chemist in Action and Teachers' Guide

3.1.6 Nuffield 'O' level Physics

This emphasises the proper handling of equipment by students in the laboratory and individual work. It is a scheme of 5 years duration.

In 1968, the Nuffield 'A' Level Science Projects in the separate sciences and physical science came into being. This scheme is for a two-year-post- 'O' level state in grades 12 and 13.

The scheme offers an integrated approach to physical science at the advanced level. It covers both chemistry and physics. The course is structured into parts namely:-

- The Basic Course
- The General Options
- The Material Options

Students are expected to design and construct a piece of equipment as project.

Materials Available for 'O' Level physics

- Nuffield Physics: Teachers' Guide I – V
- Nuffield Physics: Test and Examinations
- Nuffield Physics: Guide to Apparatus
- Nuffield Questions Books I – V
- Nuffield Physics Guide to Experiments I – V
- Nuffield Physics: Optical Instruments and Ray Diagrams for use with Year III.

SELF ASSESSMENT EXERCISE 5

1. What is the duration of Nuffield 'O' Level Physics?
2. When did the Nuffield 'A' Level Physical Science came into being?
3. Identify all the Nuffield 'O' Level Physics text materials that have direct bearing on students.

3.1.7 Nuffield 'A' Level Physics

This scheme is for two years. It has time allocation of 7 periods of 40 minutes each per week. The students are expected to study supplementary mathematics

Materials available are Teachers' Guide, Practical Guide and a book called Physics and the Engineer, and Students' Books Units 1 – 8

SELF ASSESSMENT EXERCISE 6

Name the supplementary subject which the Nuffield 'A' level physics students are expected to study.

3.2 Science Programme at Ages 5 and 13 Project

This is a science programme designed for pupils of ages of 5 and 13. The project is sponsored by Schools Council, Nuffield Foundation and Scottish Education Department. The materials are designed to help students learn by excitement and discovery. The teachers' guide is called With Objectives in Mind.

Materials available are

Working with Wood, Time, Early Experience, Science from Toys, Structure and Forces, Metals, Change, Mini-beasts, Holes, Gaps and Cavities, Trees, Coloured Things, Ourselves, Like and Unlike, and Plastics.

This project is developed from an early Nuffield Foundation called Nuffield Junior Science Project (NJSP) which has produced Nuffield Junior Science Teachers' Guide 1 and 2.

Nuffield Junior Science: Animals and Plants
Nuffield Junior Science: Apparatus

The booklets for teachers are Autumn into Winter, Mammals in Classrooms and Science and History. All published by Williams Collins.

SELF ASSESSMENT EXERCISE 7

1. Mention the sponsors of the science programmed at ages 5 and 13 projects.
2. Name the project where science programme at ages 5 and 13 projects derive its origin.

4.0 CONCLUSION

In this unit, you have studied the reasons for the emergence of Schools council Integrated Science Project as well as that of Nuffield 'O' & 'A' Levels Science Schemes. Also, you have seen the different materials available for both schemes in the sciences.

5.0 SUMMARY

This unit has discussed the following:

- The aim of SCISP is to inculcate in pupils attitudes such as critical thinking and objective observation
- Nuffield 'O' level science scheme is an attempt to reform school science education
- Nuffield 'A' level science scheme offers an integrated approach to physical sciences at the advance level. The scheme is for a two-year post 'O' level stage in grades 12 and 13.
- Science programme at ages 5 and 13 project is designed to help students learn by excitement and discovery.

6.0 TUTOR-MARKED ASSIGNMENT

1. Briefly differentiate between the 'O' Level Science Scheme of Britain and that of Nigeria.
2. Advance reasons to support the return of 'A' level (known as Higher School Certificate [HSC]) back into our educational system in Nigeria.

7.0 REFERENCES/FURTHER READINGS

Encyclopedia Britanica, Vol XVI.

UNIT 4 CONTEMPORARY ISSUES IN SCIENCE TEACHING/LEARNING I

CONTENTS

1.0 INTRODUCTION

This unit discussed some issues that have direct influence on science teaching/learning such as culture and language. You will learn more on how these issues affect science teaching/learning in our schools. The unit will focus on

- Culture and science
- Language in science

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- differentiate between culture and science
- explain the effect of culture on science teaching/learning
- define scientific language
- discuss how language in science affects science teaching/learning
- explain how science language can be developed
- explain the role of language in science teaching/learning
- discuss how to solve language problems in science.

3.0 MAIN CONTENT

3.1 Culture and Science

Culture is the way of life of a people in a community. Culture also includes rules and regulations that govern people's language, beliefs, religion, morals, etc. Education is an aspect of culture. Science has greatly affected the society and society is part of, represents the values, arts, morals and skills that are prevalent in any society. Societies exist and mirror the science that goes on in the schools. Schools are meant to perpetuate culture. Schools also serve to preserve, transmit and act as instrument of cultural change.

SELF ASSESSMENT EXERCISE 1

How does science shape the society?

3.1.1 Effect of Culture on Science Learning

Nigerian children possess substantial knowledge about every phenomenon, but their knowledge is confounded by their concepts of the supernatural. Students depend absolutely on the supernatural to answer questions. The culture the child grows up in. becomes part of him/her.

Our curriculum developers do not recognise the influence of the child's early experience on school learning.

Prominent Nigerian educators have reported findings in the effect of culture. Example: Okebukola (1986) found misconceptions of some biological concepts in Nigerian students. Okebukola attributed such misconceptions to cultural influences. Bajah (1982) attributed misconceptions to superstitious beliefs. In a study of superstitious belief, Ogunnuiyi (1982) explored the concept of life, heredity and evolution. He found that secondary school students believe that phenotype characters are determined largely by the guardian spirits of families, that albinos are products of mating that took place in the hot afternoon sun, that the sickle cell condition occurs in children sent to the world as emissaries of some divinities, such as *Sango*, *Orisa-oko*; *Sonpono*, *Ogun* and other gods), and that a child born just after the death of a close relative (particularly the grand parent) is the reincarnation of the dead relative. Nigerian children bring such culture into science classroom.

SELF ASSESSMENT EXERCISE 2

1. Is science a culture? Discuss.

2. What do you understand by "Science Culture"?

3.1.2 Contextual Learning and Culture

The construction of new knowledge (learning) is dependent on the knowledge base available, and both are contextual. This is in consonance with ideas developed by others (Brown, Collins and Duguid, 1989; Connelly and Clandinin, 1990; Solomon, 1983; Martin and Brouwer, 1991) which stress the situation of nature of cognition. Within the African context, like in any other context elsewhere, cognition cannot be separated from the socio-cultural environment.

Socio-cultural factors or the eco-culture of a learner's environment significantly affect achievement in school work (Biesheuval, 1972; Jegede and Okebukola, 1988, 1989; Jegede, 1995a & b). Glaser (1991) asserts that cognitive activity (in school and outside) is inseparable from its cultural milieu. This has also been supported by anthropologists like Ogbu (1992), who states that school learning and performance are influenced by complex social, historical, and cultural factors.

Because every society educates the younger generation as a means of passing down the socio-cultural attributes of its people, the socio-cultural factors within non-western societies become a composite part of the environment. These factors control, to a very large extent, what a child in such an environment learns and what a child becomes later in life (Ogunniyi, 1988a). Culture, as the totality of all human effort, subsumes every endeavour we undertake, including science and technology education.

Science and technology education is a cultural and human enterprise involving the transmission of the cultural heritage of a people (Gallagher and Dawson, 1984; Maddock 1981). Every investigation of human organisation ought to, therefore tackle the socio-cultural issue. Cosson (1993) also argues that since science is a human activity and a central part of our culture, it is the cultural context of science that should provide our starting point in trying to understand how people learn and how knowledge is structured. In support of the need for cultural studies in science education, Cobern (1993) opined that it is necessary for educators to understand the fundamental, culturally-based beliefs about the world that students bring to class, and how these beliefs are supported by students' cultures, because science education is successful only to the extent that science can find a niche in the cognitive and socio-cultural milieu of students. The same applies to technology education which has attracted justification from the stand point of recognising the role of indigenous knowledge in school of science and technology education (Swift, 1992).

Two major occurrences on the science and technology education arena are going to significantly affect teaching, learning and research in these areas for the next few decades and beyond. First is the remarkable shift from the old notion of science as "Science" to the notion of science as a cultural enterprise practiced by humans within a social environment. This has come a long way from the 17th century rigid, and positivist based Royal Society posture of viewing science. The second occurrence which perhaps has a broader effect and has implication for the "one world-many cultures" orientation of the modern society, is the fundamental need to recognise and probe into the alternative framework pupils from different cultures bring into science. In addition, this view has also been supportive in projecting the need for indigenous technologies (Swift 1992; Loving, 1995).

The realisation of the central role of culture in science and technology education especially in the non-Western environment where Western science is seen as second culture has prompted a proliferation of studies beginning from the mid '80s' (Jegede, 1989; 1994, 1995a & b; Jegede and Fraser, 1989, 1990; Jegede and Okebukola, 1989 a & b, 1990, 1991, 1992, 1993; Jegede and Agada, 1993; Jegede and Olajide, 1995; Jegede, Fraser and Agada, 1989; Jegede, Fraser and Okebukola, 1994; Okebukola and Jegede, 1990; Ogawa, 1986, 1995a; Ogunniyi, 1987, 1988a & b, Ogunniyi, Jegede, Ogawa and Yandilla, 1995). These and many other studies in these areas have looked at a number of issues including: factors which affect science learning in non-Western cultures, cosmology and science learning, science as a foreign culture, how to deal with the influence of traditional culture in science classrooms, and the development of instruments to measure socio-cultural environment in science classrooms, and the development of instruments to measure socio-cultural environment in science classrooms. A notable outcome of some of the studies is the identification of authoritarianism, goal structure, traditional world view, societal expectation, and sacredness of science as predictors of socio-cultural influences on the learning and teaching of science. This line of research is gathering momentum in many parts of the world and it is hoped that regions where science is taught within non-Western environments would not, in the too distant future begin to understand the issues and remedy any problems which may have for a long time mitigated the healthy study of school science and technology.

SELF ASSESSMENT EXERCISE 3

Modern Science and Technology is a foreign culture. Discuss?

3.2 Language in Science

Language is the most efficient and the most obvious mode of communication. Language according to Lindgren (1969) is a normative system of symbols or symbolic behaviour that can be use to transmit or evoke shared meanings. Symbols are abstractions, they are sound signs or gestures that represent events or objects or concepts. Bloom and Lahey (1978) define language as a code whereby ideas about the world are presented through conventional systems arbitrary to communication.

Language in science is more formal and the vocabulary of scientific writing is so different from the active vocabulary of the ordinary use of language. Banjo (1983) states that the scientific language is characterise by strange vocabularies from Greek and Latin. Because of this, language in science is problematic, more so because it involves activities like descriptions, correlation, classification and explanations, which generate terms which are technical (Gardner, 1974). The words and sentences used in science are usually long, and therefore contribute to language difficulty in reading science materials – science textbooks, journals, magazines. Hence, students find it difficult to cope. Again, teachers often communicate with students using vocabularies and patterns too high for pupils' cognitive structure.

This could with the higher abstract nature of science help to widen the communication gap in students. Ogunnuyi (1986) agrees with this argument. He sums up by stating that often the science teacher speaks a language completely alien to the students. This is because he thinks and speaks on the basis of the background experience he himself has acquired. In cases like this, the student sees such teachers as people with foreign orientation, with little or no learning taking place. The language which should have been an essential instrument to convey scientific information, and the processes for deriving them become a barrier to their understanding of science.

SELF ASSESSMENT EXERCISE 4

Differentiate between scientific language and general language.

3.2.1 Science Language Development

In developing children's language, Piaget laid emphasis on experience while Vygosky laid emphasis on language, which accompanies the experience. Both Piaget and Vygosky agree that speech affects a child's power to think. Sutton (1974) explains the process of language development in children. He states that when very young children begin to speak, speaking is linked entirely with action. It occurs only as the

child handles or points to tangible objects present. Later, words provoke visual images, and later they have a symbolic abstracted meaning that can be used in place of objects. From this point the child becomes familiar with abstracted meaning and this can be used in place of objects. From this point the child becomes increasingly capable of planning his own actions in the future. He has achieved the first liberation of his thought from the immediate context by this process of letting words stand for objects, Sutton contends. Sutton goes further to state that it is hypothesised that what the child subsequently learns to do with those words has equally far-reaching effects on his mental abilities.

Language bears an intimate relationship with thinking. This is a process that makes extensive use of linguistic symbols. The symbols of the language we use enable us to identify and define events that can be thought about and the range of symbols that can be identified by an individual, can be used as a measure of his cognitive ability of intelligence. Wharf (1969) states that the kind of language used by an individual mirrors the pattern of his thinking and perceiving.

Language consists of symbols. Symbols are abstractions, that is, they are sounds, signs, concepts, people's ideas or whatever. All cognitive functioning is based on abstractions. Judging from these facts of language development, the duty of the science teacher is first of all to know and understand how language is developed in individuals. Then they apply a similar idea in developing the scientific language to be used for and by the children. The teacher should foster children's confidence in the value of language and their own ability to use it to extend their understanding. Sutton argues that children's language develops from the specific to the general, from the personal to the impersonal and from anecdotes to the ability to consider possibilities, formulate hypotheses, reach conclusions and make judgments.

Although the language of science is already developed, the process of learning it, Sutton suggests must be one of the concerns of the science teacher.

SELF ASSESSMENT EXERCISE 5

Stress the importance of the use of symbols in science subjects.

3.2.2 The Role of Language in Science

According to Kulkarni (1987) the human mind is endowed with an ability of reactions from natural experience, an essence in an abstraction from the natural, articulating it in a manner that permits its transmission and manipulation. It is this faculty Kulkarni argues, that humans use to

derive deeper meaning from their experiences and to generate new knowledge which natural experiences in their raw form could never reveal.

> When a teacher talks to her class, draws a diagram on the board, discusses a chart on the board, or asks pupils to read a textbook, her intended meaning or that of the textbook author is not automatically transferred to the minds of the pupils. Each individual in the classroom constructs his or her own meaning from the variety of stimuli, including the specific words read or heard which are present in the learning environment. How similar the constructed meaning is to that intended by the teacher – indeed if any meaning is constructed at all depends on the way a pupil copes with the language we as teachers use so freely as our main means of instruction. (Osborne and Freybeng 1985).

Osborne and Freybeng argue that if the teachers' language includes words unfamiliar to pupils, which are not explained in the pupils' language, comprehension of what is being said will not occur. Not being able to use language makes problem solving most difficult.

According to Kemey (1959) if we had no language by means of which to convey our thought and store information, we would be little different from lower animals. Language plays a vital role in children's science learning. Science language is a bridge between learner and teacher. For effective communication in science, there is need for language.

Language in science is a crucial issue in science learning. Language in science enables the learner to understand and appreciate the concepts of science. It enables the learner to develop scientific attitude.

SELF ASSESSMENT EXERCISE 6

List 5 roles which language plays in science teaching/learning.

3.2.3 Solving Language Problem in Science

It has been said earlier that the issue of language is a critical one in science teaching and learning. Most teachers often do not admit their language difficulties in science. Where their understanding of concepts is inadequate teachers often, knowingly or unknowingly revert to the use of technical language, whether it is verbalised, written on the board or referenced from the textbook. Personal experience on surveying teachers

on practical teaching has shown that many teachers do not know certain concepts and have obscured this by shutting-students up when they ask.

There are practical solutions to science language problems. The first and foremost thing a teacher should do is to humanise science by giving practical examples from the environment and everyday life. Usually words which may be considered simple could have different meanings in different contexts – hence the need to differentiate from everyday language. Another solution could be not to assume that a word is simple. Students learning by doing is suggested for more meaningfulness in science learning. This prevents a lot of verbal communication, and reduces misunderstanding. If on the other hand, students are allowed to discuss freely, most of the language problems could be solved by exposing them.

Students should be made to note errors and be clear about the corrections as well as their own original views. In all essences, however, to avoid much of language problem, a lot of non-verbal communication materials are use for the purpose of interaction between students and objects in science. Using graphs, maps and models helps a lot. Students could record correct information through them. They state that pupils learn to be able to describe accurately what they observe and they are also able to understand the account given by other students. Measuring and counting are important contributions to such communication. Pupils share experience when they find themselves comparing objects and events using diagrams, models, etc. Schmidt and Rockcastle give some points why the use of inanimate objects is very relevant in enhancing children's science learning.

Some of these are as follows:

- they supply a concrete basis for conceptual thinking
- they concretise ideas which are abstract
- they generate a lot of interest in students
- they make learning more permanent because people remember what they see, touch, or smell more than what they are simply told (taking into cognisance the problems of language in science)
- they offer realities of experience which stimulate self activity on the part of the pupils.

Schmidt and Rockcastle have however cautioned that care must be taken in the way these objects are used as a means "of a better communication models". Because students perceive things differently and give different interpretation to what they see, touch, or hear, the meaning of what is supposed to be communicated to the students by the objects may be altered, and thereby recording incorrect information that are unscientific.

Where these are unavoidable, the science language can be made simple. For example:

- Pronunciation: The teacher should pronounce well and slowly
- Spelling: The teacher should provide correct spelling, written on the board. This also applies to every new word.
- Group work should be encouraged. It allows children to interact freely and thereby learning from each other.
- Organizing a science club is where children learn with freedom
- Ensuring that there is no unnecessary tension of examination
- New words should be explained and the origin of such words should be given e.g. photosynthesis, a Greek word meaning photo – (light), synthesis – (forming) photo-graph – (light print). Pseudopodia, pseudo – (false), podia – (feet) etc.

4.0 CONCLUSION

This unit has dealt with how culture and science relate, as well as society's misconceptions of some scientific concepts. It also discusses the development of science language, its role and how to solve problems of language in science.

5.0 SUMMARY

This unit has examined the role of language in the special structure of science that demands a specific language development. It has analysed communication and language as an aspect of communication.

Finally, it has suggested solutions to solving language problems in science.

6.0 TUTOR-MARKED ASSIGNMENT

1. Briefly explain the roles play by science in shaping our cultural beliefs in Nigeria.
2. How would you as a science teacher assist your students to develop sound science language?

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UNIT 5 CONTEMPORARY ISSUES IN SCIENCE TEACHING/LEARNING II

CONTENTS

1.0 INTRODUCTION

Science is growing, technology is growing, and the world is going scientific and technological. But the number of people doing science is not increasing, the number is depreciating. Why is this so? There are many factors that hinder people from going into science. In this unit, we will look at attitude and gender as factors that hinder people from going into science.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define attitude
- explain the effect of attitude on science teaching/learning
- mention some scientific attitudes
- define gender
- explain the effect of gender stereotyping in science
- write down comments and observations on articles read in the journals on studies on gender related issues.

3.0 MAIN CONTENT

3.1 What is Attitude?

Let us put it simply as the predisposition or tendency of an individual to react specifically towards an object, situation or value. It is usually accompanied by some feelings and emotions. You can determine someone's attitude from his behaviour. When someone demonstrates or shows an emotional behaviour towards a situation consistently, the person is said to have an attitude towards that situation. Attitude could come in form of an approach – and – avoidance response, like – dislike towards something. When you present a situation to an individual, his/her reaction to the situation is his/her attitude, be it positive or negative.

Every individual has values, when he/she expresses this fundamental values, it is said that he/she has a kind of attitude to that situation.

3.1.1 Attitude and Science Education

We said in the introduction of this unit, that the number of people who go into science is not as many as the rate at which science and technology is growing. Attitude to science education means like or dislike towards science education, an avoidance response towards science education, the feelings of disgust, repulsion, comfort or discomfort towards science education. Some are favourably disposed towards science while some are not.

SELF ASSESSMENT EXERCISE 1

Of what relevance is the study of attitude to science education?

3.1.2 Effects of Students' Attitude on Science Education

Effects of attitude depend on the kind of attitude. If it is positive attitude, the effects will be positive but if it is negative attitude, the effects will be negative.

A negative attitude causes the following:

- Poor performance of students in science learning.
- Loss of interest in science by students
- Students get disillusioned in learning science
- Students become truants
- Students develop non-challant behaviour towards science subjects.

Affective characteristics determine learning and account for educational achievement.

- A negative attitude may lead to poor performance in examinations; attitude has a causal link between performance and enrolment in science.
- The nation's aspirations for science and technology may not be achieved if the future leaders of the nation have negative attitude towards science. The future development of the nation is bleak if the citizens have a negative attitude towards science which is the *sine-qua-non* for development.

Fewer and fewer people are going into science. The few already doing science are doing very poorly in it.

SELF ASSESSMENT EXERCISE 2

What will you suggest as to what can be done to change students negative attitude to science learning in the secondary school?

3.1.3 Attitudinal Change

Attitudinal change is the change in a person's predisposition. What can lead to this change? If we must change people's attitude, we must first of all know how the attitude came about. From what is going on around us, science should hold an extrinsic value for everybody, but this is not so.

How did children develop a negative attitude towards science? Let us look at some points. On asking children that shy away from science, these reasons were given:

- Science language
- Poor background of students
- Teachers do not seem to know what they are doing in science teaching
- Some science teachers have negative attitude towards science, hence they do not teach science with zeal and enthusiasm
- Cultural beliefs and approach create a negative attitude in students
- Peer influence, stories from friends that science is a difficult subject.

We have seen some causes of negative attitude towards science. To change the attitude of students, the earlier mentioned causes must be dealt with. We can also give some suggestions as to how this attitude can be changed.

Suggestions

- Class instructions should be activity based and evaluation should depend on a multiple acceptable solutions.
- Identify content that has some meaning within everyday life of the students
- Take into consideration, students' interests and suggestions of activities
- Involve students in learning activity, as this boosts their ego.
- Do something about the mathematical nature of science-figures that scare many students.
- Simplify high conceptual level of science as much as possible
- Simplify science language and give examples where necessary
- Practical work should be part of science teaching
- Seek feedback constantly
- Teachers should show enthusiasm and zeal in teaching science.

3.1.4 Attitudinal change and Science Education

Science is learnable. Many people cannot learn science because of the negative attitude they brought to science learning. Attitudes can be changed when we:

- Adopt very stimulating methods used in science teaching, (because learners begin to appreciate science learning).
- Make science interesting and relevant to learners.
- Provide materials
- Get the learners involved in science learning – learning by doing
- Humanise science

SELF ASSESSMENT EXERCISE 3

What is your attitude to science?

3.1.5 Developing Scientific Attitude

You have seen some suggestions that can help students to change their attitude. Scientists have some attributes that one needs to acquire in order to develop a scientific attitude. These are:

- Curiosity
- Logic
- Reasoning
- Open-mindedness
- Objectivity

- Patience/Tolerance
- Humility
- Skepticism
- Honesty
- Creativity
- Critical thinking (Rationality)

SELF ASSESSMENT EXERCISE 4

Discuss any attributes of a scientific attitude.

3.2 Gender and Science Education

Gender in science is the classification of the role of males and females in science, technology and mathematics (STM). This is the consequence of gender stereotype which has classified different roles for men and women in the society. Gender stereotype is responsible for the low representation of women in STM. Women in science came into lime light during the United Nations Decade for Women (1976 – 1985) which addressed women in development. The UN activities exposes the low representation of women in science and the challenges confronting women in choosing and performing well in science related fields (Hammrich, 1997 and Hammrich *et al*, 2000, quoted by Ezeliora, 2004).

It is sad to note that the baby girl is exposed to avoid STM from birth. The societal set up did not give her the opportunity to experience the environment which is pre-requisite to science. Rather, she was kept in doors to do the house work while her brother is left to move about exploring the environment (Alele – Williams, 1983 and Ezeliora, 2003). She is lately exposed to school, even at that level her curriculum did not emphasise science as to awaken in her the interest and curiosity to seek for science (Ezeliora, 1999). While in school, her parents and teachers never expected her to do more than required by the society nor encouraged her to choose a career in STM (Fox, 1976), but her brother is prided to read engineering, medicine, pharmacy etc. Those girls who braved it to science received disapproval for trading in the masculine field. As a result of all these many girls perceived science as masculine and a no-go area for girls (Fox, 1976).

SELF ASSESSMENT EXERCISE 5

As a science teacher, how will you influence more of girls' participation in STM at the secondary school level?

3.2.1 Studies on Gender Related Issues and Achievement in STM

The association between gender and the response to STM education has been widely studied in recent years. Such studies include Head and Ramsden (1990) and Raimi (1999). The main focus of their findings is lack of girls opting to study the physical sciences. Studies on gender differences in STM achievement, interest and participation are enormous in science education literature. Inspite of the large number of such studies more investigations are still being undertaken in this area. This is so because a definite and stable picture in respect of gender differences in STM achievement is yet to emerge. Rather, what is evident is that there are three conflicting pictures in respect of gender differences in STM achievement. For instance, some schools of thought feel that gender difference has to do with cognitive abilities (Graybill 1975), while others believe that subject choice and achievement are probably controlled by affective factor (Peter *et al*, 1994). Extant literature on the effect of gender differences on STM achievement reveals conflicting findings in this connection. The first portrays a significant gender effect in favour of males, the second portrays a significant gender effect in favour of females while the third portrays non-significant gender effect all in relation to the overall achievement in STM education.

Significant gender difference in favour of boys was reported by such researchers as Raimi and Akinyemi (1997). They observed poor employment and poor performance among females. They also observed that this has often led to the acute shortage of the number of females that gain access to scientific studies and technological training at tertiary institutions.

SELF ASSESSMENT EXERCISE 6

Look for two reputable science journals (preferably 2004 and 2005) which reported researches on gender and achievement in STM education. Write out their findings.

3.2.2 How to Increase Women Participation in STM Education

It is a known fact that gender socialisation and stereotype, more than anything else are responsible for women's low interest, achievement and attitude to STME. We should all make effort towards redressing the situation such that the formal and informal education of women could be enhanced to facilitate their entry into STME. So parents, teachers, government and non-governmental organisations and the Nigerian public, all have a role to play in order to achieve this important objective.

Science teachers should for example, seek to eliminate all forms of gender-stereotyped behaviours in the form of verbally expressed or non-verbally expressed expectations, praise, criticisms, reward, interaction level, language and communication, whenever they relate with students.

Government should formulate and implement policies that would increase female enrolment in secondary schools since it is at this level that formal education in STM realistically begins. Agencies could also be established for promoting sex equality in education and employment.

Professional bodies such as Association of Women in Science, Technology and Mathematics (NAWSTEM), Nigerian Academy of Education, Science Teachers' Association of Nigeria (STAN) and National Mathematical Association can also assist in facilitating greater female participation in STME by organising workshops, seminars, conferences, talk-shops etc on participation in STM education.

SELF ASSESSMENT EXERCISE 7

Discuss some other ways by which women's participation in STME can be further enhanced.

4.0 CONCLUSION

In this unit, you have been introduced to students' attitude to science as a pre-disposition to science learning which can be negative or positive.

Students' attitude to science is dynamic depending on the situation in which the learning is taking place. The unit also discusses issues on gender and science. It further explains some problems on female representation in STM as well as how to increase women's participation in STME.

5.0 SUMMARY

This unit, examines the following:

- The meaning of attitude and attitude to science
- Effects of students attitude to science education
- Attitudinal change to science
- Developing scientific attitude
- The meaning of gender
- Findings on gender and achievement in STM.
- How to increase women's participation in STME

6.0 TUTOR-MARKED ASSIGNMENT

Discuss how you will enhance students' positive attitude to the learning of STME.

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UNIT 6 CURRENT ISSUES IN SCIENCE EDUCATION IN NIGERIA I

CONTENTS

1.0 INTRODUCTION

This unit will examine some of the recurring current issues known to have impact on science education in Nigeria. This will enable you as science educator to know how to monitor the progress and development of science education in Nigeria. This unit will focus on:

- Science Curriculum Development and the National Policy on Education (NPE)
- The Science Curricula and the Problems of Implementation

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- state the general objectives of primary science as contained in the National Policy on Education (NPE)
- itemise what the integrating principles of integrated science at Junior Secondary School are intended to produce
- discuss some of the criticisms of the science curricula according to Irowi (1982)
- discuss factors essential for proper implementation of science curricula
- discuss the problems of implementation of both primary and secondary science curricula.

3.0 MAIN CONTENT

3.1 Science Curriculum Development and the National Policy on Education

In line with the NPE and the 6 - 3- 3 - 4 education system there has evolved a core curriculum for primary school science produced by the Federal Ministry of Education. The unifying general objectives as contained in the core curriculum for primary science are, to:

- Observe and explore the environment
- Develop basic science processes including observing, manipulating, classifying, communicating, inferring, hypothesising, interpreting data formulating models.
- Develop functional knowledge of science concepts and principles
- Explain simple natural phenomena.
- Develop scientific attitude including curiosity, critical reflection and objectivity
- Apply the skill and knowledge gained through science to solving everyday problem in his environment
- Develop self confidence and self reliance through problem solving activities in science
- Develop a functional awareness of and sensitivity to the orderliness and beauty in nature (F.M.E, 1998)

Integrated science was recommended for Junior Secondary School. The essence of which is to introduce scientific concepts to students at early level of their secondary education. Hence, the integrating principles are intended to produce a course which:

- Is relevant to student needs and experience
- Stresses the fundamental unity of science
- Lays adequate foundation for subsequent specialist study and
- Adds a cultural dimension to science education.

The scientific concepts and principles are presented in such a way that the students

- Gain the concepts of the fundamental unit of science
- Gain the commonality of approach to problems of a scientific nature
- Are helped to gain an understanding of the role and function of science in everyday life, and the world in which they live.

The science curricula in biology, chemistry, physics, agricultural science, health science and mathematics like the curricula for other subjects can be said to be a product of a multiple agency approach to curriculum development. This was because they were jointly developed by the STAN, CESAC, WAEC, the State Ministries of Education and Nigerian universities.

The curricula have, however, come under criticism by experts in the field of science education. Odunsi (1978) observed that there was a growing gap between what students learnt at school and what they were required to cope with in the technological oriented society in which they live. Ivowi (1982) reports that the curriculum objectives are over ambitious. Consequently, they have been found difficult to achieve in reality in all the subjects. He further observes that the content is overloaded and practical work is not available in most schools. He also observes were that, most science teachers do not adopt the prescribed instructional techniques in implementing the programme.

By now, some teachers have come to realise that the context, content and level of treatment of the topics in the teaching syllabi are quite different when compared with the erstwhile General Certificate Examination (GCE) Ordinary Level (Adeyegbe, 1993). Some curriculum analysts have come to the conclusion that the syllabi have 25% of Advanced Level topics injected into them. The framework of the science curricula has been built on students' acquisition of knowledge and understanding of:

- Scientific phenomena
- Scientific vocabulary, terminologies and conventions
- Scientific and mathematical instruments and safety aspects
- Scientific and technological applications with their sociological, economic and environmental implications.

It is widely believed that the contents of the curricula share a lot in common with the present syllabi now being examined by most examination bodies in the United Kingdom. The implementation of the science curricula is predicated on:

- High calibre of cognitive; talented students from the JSS level
- Availability of academically competent, professionally sound and enduringly committed teachers
- Provision of moderately equipped laboratories and libraries
- Reasonable teacher-pupil ratio and
- Well trained laboratory technicians

SELF ASSESSMENT EXERCISE 1

Enumerate what you will consider as the prior knowledge of your Senior Secondary School One (SSS 1) student in science subjects.

3.2 The Science Curricula and the Problems of Implementation

The content of the primary school science curriculum has been modified in line with the societal changes over the years. But the salient fact is that the development of science was brought about as a result of external influence, particularly that of United States of America. Bajah (1982) refers to this as "conceptual imposition". Adesoji (1994) was of the view that, "the language of Western education including the knowledge provided by Western science is different from that of the Nigerians and Africans in general". Okeke and Inomiesa (1986) argued that for science to be well related to the pupils' environment pupils should be made to observe and explore such environment, otherwise, the study of science will be abstract and thus become difficult for pupils. In order to bring science closer to pupils in Nigeria, the first step is by introducing its teaching in the indigenous languages. This is necessary in view of the fact that many of our primary school students have shallow background in the use of English, which is currently the medium of instruction. Ironically, primary school teachers at times, resort to interpreting whatever they teach in English in indigenous languages such as Yoruba, Igbo and Hausa.

Fafunwa (1982) is of the opinion that the products of primary schools are neither proficient in English nor in their mother tongue. He further states that no other nation in the world, except most of the ex-colonies or those countries still under colonial rule, prepare their children for adult undertakings in languages foreign to them. The curriculum should therefore be based on local languages and locally available materials in order to make its implementation by the teachers an easy one.

The problem of integrated science range from misinterpretation of the concept of "integration" to the problem of implementation. If the aim of integrated science is to produce students who will be scientifically literate in terms of the unity of science then, the subject boundaries should be fully broken and the curriculum should be based on the concepts, which would then be explained from the knowledge of the different areas of science. Some of the textbooks of integrated science focus attention on different topics according to the different areas of science. This should not be the right approach. From the studies of researchers including those of Olanrewaju (1982) and Okebukola and Adeniji (1982), the major constraints in the implementation of integrated

science curriculum are those of material resources and the quality and quantity of teachers of the subjects.

The additional advanced level topics in the senior secondary science curricula are not only difficult for students but also difficult to some of the teachers. Adeyegbe (1993) writes that, "Some research studies have indicated the inability of some teachers to teach genetics in biology, chemical calculations in chemistry, nuclear physics in physic" etc.

SELF ASSESSMENT EXERCISE 2

List five constraints in the implementation of integrated science curriculum in Nigeria.

4.0 CONCLUSION

This unit, has introduced you to some current issues in science education, namely science curriculum development and NPE as well as the problems of implementation of the science curricula. In the next unit, you will be exposed to some other important issues that have impact on science education.

5.0 SUMMARY

This unit, has shown that:

- The NPE laid emphasises on science curriculum development right from primary school level to tertiary level.
- The NPE recommended the teaching of integrated science in Junior Secondary level
- The curricula on other science subjects were jointly developed by STAN, CESAC, and WAEC etc.
- Some problems encountered during the implementation of the science curricula are language, misinterpretation of the concept of integration, difficulties of Advanced Level topics added to the Senior Secondary curricula which are difficult for both the students and the teachers.

6.0 TUTOR-MARKED ASSIGNMENT

As a science teacher, discuss what you will recommend as a permanent solution to the problems you encountered in the implementation of the Senior Secondary science curricula in Nigeria.

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UNIT 7 CURRENT ISSUES ON SCIENCE EDUCATION IN NIGERIA II

CONTENTS

1.0 INTRODUCTION

This unit is a continuation of Unit 20 in terms of discussion on current issues in science education. But in this unit, you will be exposed to the following:

- The Learner and the Science Curricula Implementation
- The Learners' Performance in the Sciences

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- discuss the involvement of learners in the science curricula implementation
- list five elements that determine students' rate of learning
- discuss the causes of underachievement and low enrolment in science subjects in Nigeria
- mention some of the factors proposed by science educators as a way out of the poor achievement in science subjects.

3.0 MAIN CONTENT

3.1 The Learner and the Science Curricula Implementation

The curriculum is externally imposed on the learner and its implementation is the function of the teacher who makes use of the "appropriate" method. The fact of the situation is that no amount of direction and teaching can force a child to learn. Learning is a function of the child. If a child wants to learn he does so. According to an American psychologist, Jerome Brunner who is a leading proponent of

social constructivism, children do not invent or discover how to adapt their thinking and act intelligently in new situations by themselves.

These processes are developed by negotiation and interaction with more mature peers and teachers. A learner will have to process information before permanent learning or changes in behaviour can occur. Cognitive processes are those that liberate the organisms' behaviour from the immediate dictates of the environment. The disparity in the ways we process information is brought about by individual differences. For a learner to be proficient in problem solving (characteristics of all aspects of science), he has to be able to process information in a diverse form.

The situation in our schools today as to the way instructions are planned does not appreciate differences in the way students learn. Schemes of work are planned in such a way that topics are arranged on weekly bases. The planner does not realise that some students would master the material quickly and easily, but others would progress only slowly and incompletely. In some cases, teachers would need to provide extra instruction and practice opportunities to slower students. Caroll (1963) argued that differences in mastery levels were produced not by inherent differences in learning potentials but by differences in the time needed to learn (some students may take longer to master the material, but they will master it if given enough time).

$$\text{Degree of learning} = \frac{\text{Time actually spent}}{\text{Time needed}}$$

This model implies that all students can master the curriculum if given enough time to do so. Caroll suggested that five elements determine students' rates of learning. These are, aptitude, ability to understand instruction, task perseverance (student engaged time on the task), opportunity to learn (allocated instructional time) and quality of instruction.

SELF ASSESSMENT EXERCISE 1

Briefly explain how you will handle the slow learners when teaching any of the science subjects in your school.

3.2 The Learners Performance in the Sciences

Research literature reported that students in Nigeria do not perform well in the sciences (Ogunleye, 1985; Okpala and Onocha, 1995 and Adeoye, 2000). The problem of underachievement and low enrolment in the sciences are not limited to Nigeria. The same problems have been

reported particularly in physics and chemistry by scholars (Crawley & Black, 1990; Albanese and Mitchell, 1993). The question we may want to ask is, "why are our students are performing woefully in the sciences"? The following factors are recognised through empirical researche:

- Lack of motivation from examination results (Nwagwu, 1981)
- Lack of qualified science personnel and equipment (Abdullahi, 1982)
- Teacher related factors such as poor teaching methods (Bakare, 1986)
- Learner related factors such as misconception of some scientific concepts (Marek, 1986)
- Home factors such as, negative attitude of parents (Dunmoye, 1989)
- Adverse effect of foreign language as a medium of instruction (Babalola, 1991)
- Frequent closure of schools (Ideye, 1992)
- School environment factors such as undesirable classroom environment (Jegede, 1992); inappropriate medium of instruction (STAN, 1992), an overloaded curriculum (Adeyegbe, 1993) and admission of unqualified students (Igwe, 1994)
- Lack of training and retraining of personnel (Ivowi, 1993)
- Poor classroom management (Pwol, 1993)

According to Raimi (2002), despite the fact that the present science curricula recommended the teaching and acquisition of science process skills, most secondary school teachers often pay little attention to practical work. He further reported that from personal observation, when practical lessons are held by teachers, they are usually held too close to the final examination period, especially SSCE.

In order to bail our students out of the poor achievement in science, new methods of instruction have been advocated. These include cooperative learning (Bolaji, 2002), process approach (Raimi, 2002), problem solving technique (Adesoji, 1991), framing and team-assisted instruction (Igwe, 2002), peer tutoring and explicit teaching (Ajila, 2002) and many others. Other learner characteristics such as ability and gender have also been investigated and found to affect the learning of science. The interest in gender may be as a result of the concept of egalitarianism in the National Policy on Education. Beside, gender equity in the learning of science is now the order of the day. But it is of interest to note that few females are still found in science and technology (Iroegbu, 1998).

We may then ask ourselves, "Is this due to lack of interest in science or that, girls find it difficult to process information"? At present, the number of females who proceed beyond secondary school level is less than 30%.

Of this few, the number who pursue career or studies in science or mathematics related courses are extremely low (Oyedeji, 1996). Effect of gender on students' learning outcome in mathematics and sciences is still a major point or debate among educators. This is due to the conflicting nature of results from researches. For instance, Okpala and Onocha (1988); Raimi and Akinyemi (1997) have found significant gender group differences (in favour of boys). Studies such as that of Iroegbu (1998) did not establish such differences. But, Adeoye (2000) which found significant gender group differences reported that female achieved better than male when test items are based on science concepts that require learners of medium numerical ability while the reverse was the case when the test was based on concepts that require high numerical ability.

SELF ASSESSMENT EXERCISE 2

1. What do you think can be done to enhance the presence of more female in the learning of sciences?
2. When do you think the female students can out perform their male counterparts in the sciences?

4.0 CONCLUSION

In this unit, you have been introduced to how science teachers implement the science curricula in school differently with some taking into cognisance the nature of the learners and some seeing the learners as the same. It also discusses the learners' performance in science with emphasises on some research findings.

5.0 SUMMARY

This unit, you teaches how to enhance the implementation of the science curricula and the performance of our students in the sciences.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss the problems which the implementation of the science curricula may face in a country that relies on importation of science and technology.

7.0 REFERENCES/FURTHER READINGS

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