NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: EDU 254

COURSE TITLE: SUBJECT METHODS (INTEGRATED SCIENCE)

MAIN COURSE

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COURSE GUIDE

EDU 254
SUBJECT METHODS (INTEGRATED SCIENCE)

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INTRODUCTION

The Course Guide tells you briefly what the course is about, what course materials you will be using and how you can work your way through these materials. It suggests some general guidelines for the amount of time you are likely to spend on each unit of the course in order to complete it successfully. It also gives you some guidance on your tutor– marked assignments. Detailed information on tutor–marked assignments is found in the separate Assignment File, which will be available to you.

WHAT YOU WILL LEARN IN THIS COURSE

This course is to bring to consciousness of those to be involved in Integrated Science teaching at junior secondary level. So the overall aim of EDU 254 (Subject Methods) Integrated Science is to introduce you to some of the rudiments of integrated science teaching. You will as well learn about the meaning of integrated science, philosophy and objectives of integrated science and the nature of science; science education curriculum reforms at both primary and secondary school levels and psychological theories of learning and its implications for science teaching. You will learn also the process of improvisation and the relevance of ICT in teaching and learning process as well as the importance of integrated science laboratory its safety and management.

COURSE AIMS

The aim of this course is to prepare you towards teaching integrated science at junior secondary level. This will be achieved by aiming to:

* Help you appreciate the nature of science
* outline all the science education curriculum reforms at both primary and secondary levels in Nigeria
* historical development of integrated science, its philosophy and objective
* examine the contributions of some cognitive psychologists like Jerome Brunner, Robert Gagne and Jean Piaget to enhance our knowledge of the nature of science teaching
* deal with the basic methods and techniques of teaching integrated science.
* Resources for teaching integrated science
* Understand the relevance of integrated science laboratory, safety and management
* Explore the relevance of ICT in the teaching and learning of Integrated Science
* Deal with different methods of evaluations of science teaching and learning in integrated science

COURSE OBJECTIVES

To achieve the aims set above, the course sets overall objective. In addition, each unit has specific objectives included at the beginning of a unit. You may want to refer to them during and after you might have completed a unit to check on your progress.

Set out below is wider objectives of the course as a whole. By meeting these objectives, you should have achieved the aims of the course as a whole.

On successful completion of the course, you should be able to:

- explain the nature of science
- advance reasons for science education curriculum reforms in Nigeria
- trace the historical development of integrated science in Nigeria
- discuss the concept of integration
- compare the characteristics of integrated science and non-integrated science
- understand the philosophy and objectives of integrated science
- discuss the contributions of some cognitive psychologists such as Brunner, Gagne and Piaget to science teaching and their implication for teaching integrated science
- outline the methods of teaching integrated science
- describe the various resources for teaching integrated science and improvisation
- use ICT in the teaching and learning of integrated science
- prepare a scheme of work, lesson plan and lesson note for teaching integrated science in junior secondary classes
- design, organize and ensure safety in integrated science laboratory
- develop test items for multiple choice and essay in integrated science and other methods of evaluations applicable in assessing outcomes

WORKING THROUGH THE COURSE

To complete this course, you are required to read each study unit of this study material and read other materials, which may be provided by the National Open University of Nigeria. Each unit contains self-assessment exercises for this course and at certain points in the course you would be required to submit tutor marked assignments for assessment purposes. At the end of the course, there is a final examination. The course should take you about a total of 17 weeks to complete. Below you will find listed all the components of the course, what you have to do and how you should allocate your time to each unit in order to complete the course on time and successfully.

I would advice that you avail yourself the opportunity of attending the tutorial sessions where you will have the opportunity of comparing knowledge with your peers.

THE COURSE MATERIALS

Major components of the course are:

1. The Course Guide
2. Study Units
3. References
4. Assignments
5. Presentation Schedule.

STUDY UNITS

There are thirteen study units listed under three modules in this course. They are as follows:

Module 1: Historical Development of Integrated Science

Unit 1: Nature of Science
Unit 2: Science Education Curriculum Reform in Nigeria I
Unit 3: Science Education Reform in Nigeria II
Unit 4: Historical Development of Integrated Science Curriculum in Nigeria
Unit 5: Concept of Integrated Science

Module 2 Philosophical and Psychological Development of Integrated Science

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Unit 1: Philosophy and Objectives of Integrated Science
Unit 2: Psychological Theories and Implications for Teaching Integrated Science I
Unit 3: Psychological Theories and Implications for Teaching Integrated Science II
Unit 4: Methods of Teaching Integrated Science
Unit 5: Resources for Teaching Integrated Science

Module 3: Techniques for Teaching Integrated Science

Unit 1: Planning for Integrated Science Teaching

Unit 2: Integrated Science Laboratory, design, safety and Management
Unit 3: Evaluation Procedures of the Outcomes in Integrated Science teaching and learning process

Each unit consists of table of content, introduction, statement of objectives, contents, conclusion, summary, tutor marked assignment and references. There are activities written at every point. These activities will assist you in achieving the stated objectives of the individual units and of the course.

PRESENTATION SCHEDULE

Your course materials will give you important dates for the early and timely completion and submission of your TMAs and for attending tutorials. You should remember that you are required to submit all your assignments by the stipulated time and date. You should guard against lagging behind in your work.

ASSIGNMENT FILE

There are thirteen assignments in this course. That is one assignment per unit. These are designed to ensure that you really understood each of the units. In this file, you will find all the details of the works you must submit to your tutor, for marking. Remember your assignments are as important as the examinations as they carry weightings of 30% for undergraduate.

ASSESSMENT

Two major methods will be used to assess the course. The first major method is through assignments while written examination will be the second one. The course material had been prepared to assist you to do these assignments. You are also expected to use information and knowledge from the recommended text at the end of each unit. The assignment will carry 30% of the total marks for the undergraduate students. Final examinations of about two hours duration will be written at the end of the course and this will also carry 70% of the total marks for the undergraduate students.

TUTOR-MARKED ASSIGNMENT (TMAS)

The TMA is a continuous assessment component of your course. It accounts for 30% of the total score. You are required to submit at least four (4) TMAs before you are allowed to sit for the end of course examination. The TMAs would be given to you by your facilitator and you are to return them to same as and when due.

Assignment questions for the units in this course are contained in the assignment file. You will be able to complete your assignment from the information and materials contained in your study units and references.

However, it is desirable to demonstrate that you have read and researched more into other references, which will give you a wider view point and may provide a deeper understanding of the subject.

Make sure that each tutor-marked assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you cannot complete your work on time, contact your facilitator before the assignment is due to discuss the possibility of an extension. Extension will not be granted after the due date.

FINAL EXAMINATION AND GRADING

The final examination for EDU 254 will be for two hours duration and will carry 70% of the total marks for undergraduate students. The examination will consist of questions, which reflect the type of self testing, practice activities and tutor-marked assignments/problems you have encountered previously. All areas of the course will be assessed.

You may wish to form a discussion group of considerable numbers of your colleagues and practice or discuss the activities and assignments written in each unit before the examination period.

COURSE MARKING SCHEME

Assessment	Category of Student	Scoring	Mark
Assignment 1 – 13	3 for undergraduate	Each counts for 10 marks	30 marks
Final Examination	Undergraduate		70 marks
TOTAL			**100% of course marks**

HOW TO GET THE MOST FROM THIS COURSE

1) In distance learning, the study units replace the university lecture. This is one of the advantages of distance learning. You can read and work through specially designed study materials at your own pace, and at a time and place that suits you best. Think of it as if you are reading the lecture instead of listening to the lecturer. In the same way a lecturer might give you some reading to do, the study units tell you when and what to read. You are provided with exercises, to do at appropriate points, just as a lecturer might give his/her student an in-class activity.

2) Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit, and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These objectives allow you to know what you should be able to do, by the time you have completed the unit. These learning objectives are meant to guide your study. The moment a unit is finished, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course.

3) The main body of the unit guides you through the required reading from other sources. This will usually be either from your references or from a reading section.

4) Self activities are interspersed throughout the units, working through these activities will help you to achieve the objectives of the unit and prepare you for the assignments and the examination. You should do each self activity as you come to it in the study unit.

5) The following is a practical strategy for working through the course. If you run into any trouble, telephone your tutor or visit the study centre nearest to you. Remember that your tutor's job is to help you. When you need assistance, do not hesitate to call and ask your tutor to provide it.

Read this Course Guide thoroughly, it is your first assignment.

1) Organize a Study Schedule- Design a 'Course Overview' to guide you through the Course. Note the time you are expected to spend on each unit and how the assignments relate to the units. Important information, e.g. details of your tutorials, and the date of the first day of the Semester is available at the study centre. You need to gather all the information into one place, such as your diary or a wall calendar. Whatever method you choose to use, you should decide on and write in your own dates and schedule of work for each unit.

2) Once you have created your own study schedule, do everything to stay faithful to it. The major reason that students fail is that they get behind with their course work. If you get into difficulties with your schedule, please, let your tutor know before it is too late for help.

3) Turn to Unit 1, and read the introduction and the objectives for the unit.

4) Assemble the study materials. Information about what you need for a unit is given in the 'Overview' at the beginning of each unit.

You will always need both the study unit you are working on and one of your text books on your desk at the same time.

5) Keep an eye on the course information that will be continuously posted to you. Visit your study centre whenever you need up to date information.

6) Well before the relevant due dates (about 4 weeks before due dates), visit your study centre for your next required assignment. Keep in mind that you will learn a lot by doing the assignment carefully. They have been designed to help you meet the objectives of the course and, therefore, will help you pass the examination. Submit all assignments not later than the due date.

7) Review the objectives for each study unit to confirm that you have achieved them. If you feel unsure about any of the objectives, review the study materials or consult your tutor. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to space your study so that you can keep yourself on schedule.

8) When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the Assignment is returned, pay particular attention to your tutor's comments, both on the tutor-marked assignment form and also the written comments on the assignments, consult your tutor as soon as possible if you have any questions or problems.

9) After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in the Course Guide).

TUTOR AND TUTORIALS

Tutorials shall be provided in support of this course. You will be notified of the dates, times and location of these tutorials as well as the names and phone number of your facilitator, as soon as you are allocated a tutorial group.

Your tutor or facilitator will mark and comment on your assignments, keep a close watch on your progress on any difficulties you might encounter and provide assistance to you during the course. Submit your tutor-marked assignment to your tutor before the due date; at least two working days are required. They will be marked by your tutor and returned to you as soon as possible.

Do not hesitate to contact your facilitator on telephone, e – mail and discuss problems if you need assistance. The following might be circumstances in which you would find help necessary. Contact your facilitator if:

- You do not understand any part of the study units or the assigned readings.
- You have difficulty with the self-test or activities.
- You have a question or problem with an assignment, with your tutor's comment or with the grading of an assignment.

You should try your best to attend the tutorials. This is the only chance to have face to face contact with your course facilitator and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain much benefit from course tutorials prepare a question list before attending them. You will learn a lot from participating in active discussion.

SUMMARY

EDU 254 intends to introduce you to Subject Methods (Integrated Science). Upon completing the course, you will be equipped with basic knowledge and skills that will place you in the status of practicing integrated science teachers.

Among others, you will be able to answer these kinds of questions:

- What is the nature of science?
- What are the possible reasons for science curriculum reforms in Nigeria at both primary and secondary school levels?
- How have the psychological theories of learning contributed to the teaching of integrated science in our schools?
- Which of the teaching methods will you suggest for the teaching of integrated science in our schools?
- What materials can you use for teaching integrated science topics and how will you select them?
- What are relevance of ICT in integrated science education?
- How can you manage the resources in the science laboratory?
- What are the roles of the integrated science teacher in integrated science laboratory?
- How will you assess integrated science practical lessons in your school?

MODULE 1: HISTORICAL DEVELOPMENT OF INTEGRATED SCIENCE

INTRODUCTION

In this module, the student is exposed to the nature and spirit of science. The module will examine the trend in science curriculum reform in Nigeria that introduced integrated science at the lower level of secondary school education and primary level. The module will also examine the concept of integrated science and STEM (science, technology, engineering and mathematics). The module is divided into five (5) units namely:

Unit 1: Nature of Science
Unit 2: Science Education Curriculum Reform in Nigeria 1
Unit 3: Science Education Curriculum Reforms in Nigeria 11
Unit 4: Historical Development of Integrated Science Education in Nigeria
Unit 5: Concept of Integrated Science and STEM

UNIT 1: Nature of Science

CONTENTS

1.0 INTRODUCTION

In this unit you will learn the nature of science as well as the science education curriculum reforms in Nigeria that gave rise to Integrated Science in our school system. In this unit the concept of Integrated Science will be examined.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Explain the nature of Science
- List the processes or methods of science
- List and explain the scientific attitudes

3.0 MAIN CONTENT

3.1: Nature of Science

Science is an attempt to explain natural phenomena. Science is a body of organized knowledge acquired through a process of inquiry(Ezeliora, Ezenwabachili, Aneke & Aghadinuno, 2011). Baja (1992) beautifully described science as the continual search for adequate methods of understanding our environment. Abd-El-Khalick., Bell & Lederman (1998) explained the nature of science as making the unnatural natural. There are methods or processes peculiar to science in determining the facts about nature. They are called scientific method or process. They include identifying problem, observation, classification, measuring, prediction, analyzing, inferring, synthesizing, describing, experimenting. In the process of carrying out the scientific processes the individual develops certain attributes known as scientific attitudes namely suspending judgement, objectivity, curiosity, humility, skepticism and open-mindedness which are beliefs, values, qualities and opinions held in awe by scientists. In order words, nature of science is those qualities which make science what it is. The nature of science is described using three basic elements of science namely:

- The process of science
- The product of science
- The human attitudes of science

In investigating phenomenon or event, scientific processes are uses to gather data but the product of science will be applied in analysis and interpretation. The human attitudes of science remain in focus at any point of the investigation. Application of science method and attitudes of science leads to new scientific knowledge which subsumed under the old ones.

SELF ASSESSMENT EXERCISE 1

What do you understand by these terms in relation to science: concepts, laws, theories and principles?

3.2: Scientific Law:

A law is a statement of what happens or will happen under a given initial condition. When a theory survives many tests and becomes accepted as true, it becomes a scientific law. For example, Charles Law, Boyle's Law etc. For a statement to be a law, it must express a uniformity among observation of natural phenomena and must involve the use of concepts. Scientific law may change as new information is produced.

SELF-ASSESSMENT EXERCISE 3

3.3: Explain the term science process skills

As pointed out by Abd-El-Khalick et (1998) science is making the unnatural natural. This involves a lot of activities and methods known as scientific method. It is in the application of these methods that unnatural are made natural. Such activities include observation, measuring, classification, inferring, experimenting and prediction and so on. When students apply these methods in the process of acquiring scientific knowledge, they develop the skills of observation, measuring, classifying, experimenting , inferring and predicting. These skills are called science process skills.

SELF-ASSESSMENT EXERCISE 4.

3.4: Explain the term scientific attitude.

In the process of learning science, students are involved in many activities in the they applied scientific methods. These activities will develop in the students scientific skills of observation, measuring, recording classifying e.t.c. And while the students have acquired these skills they will develop scientific attitudes of honesty, humility, critical and judgemental mind. These are called scientific attitudes. There are about seven of them. Thus Hodson (2009) pointed out that in the teaching and learning about science, language, theories, methods, history, traditions and values are acquired also.

4.0: CONCLUSION

However, the major goal of science is to unravel the mysteries of nature using the same tools and methods. The processes of science are unique and dependable and thus make investigations of science replicable. The scientific method is applicable in all fields of knowledge. The scientific method as well as attitudes of science brings about the product of science. The processes, attitudes and products of science combine to give science its nature.

5.0: SUMMARY:

In this unit we have discussed scientific methods or processes of science, the attitudes which enable these processes to remain what they are and the products of science. Furthermore, scientific truths or facts can be rejected if more experiments and observations are carried out. In order words scientific enterprise is not necessarily a finished business because as more facts emerge, new questions are raised and new explanations are proffered.

6.0: TUTOR-MARKED ASSIGNMENT

1. Discuss briefly the term nature of science
2. Differentiate between processes of science, product of science and scientific attitudes

7.0: REFERENCES/FURTHER READINGS

Abd-El-Khalick, F., Bell, R. L. and Lederman. N. G. (1998). The nature of science and instructional practice: Making the unnatural natural. **Science Education, 82(4) 417-436**

Bajah, S. T. (1992). Rethinking science education in Nigeria: The way forward. Paper presented at Lagos State University. **STAN News Letter.**

Ezeliora, B; Ezenwabachili, C; Aneke, M. and Aghadinuno, M. C. K (2011). **Manual for re- training of teachers of primary schools for the teaching of basic science and technology.** Snaap Press ltd, Enugu.

Hans, P. P. (2019). **Public understanding of science.** Research Center, Julich and Free University of Berlin, Germany

Hodson, D.(2009). **Teaching and learning about science: Language, theories, methods, history, traditions and values.** Sense Publishers: Rotterdam

Lederman, N. G. (2007). Nature of science: Past, present and future in Abell, S. K. and Lederman, N. G. (eds) **Handbook of Research on Science Education.**

UNIT 2: SCIENCE EDUCATION CURRICULUM REFORM IN NIGERIA 1

1.0: INTRODUCTION

This unit introduces you to the curriculum reforms in science education and primary science curriculum projects embarked upon in Nigeria.

2.0: OBJECTIVES

After the studying this unit, you should be able to:

- Advance reasons for a reform in the science curriculum
- List some primary science curriculum projects
- List the financiers of each of the primary projects
- Mention the dates when each of the projects was initiated
- Mention the focus of each of the projects
- List the curriculum materials produced for the execution of the projects

3.0: MAIN CONTENT

3.1: Science Curriculum Development

The sudden launching into space of the satellite "Sputnik" by Soviet Union sparked off science curriculum development efforts in the western world. This led to the awareness as regards the need to re-examine the school science curriculum, objectives and evaluation.
In Nigeria, a lot of external influences and foreign curricula motivated many of the curriculum innovations in science at the primary school level. Some of the foreign curricula are Elementary Study of Science (ESS) IN 1960; S-A Process Approach (SAPA) of 1962;Science Education for Africa Project (SEAP) of 1970: Science Teacher Education Project (STEP) of 1970: and so on. Because of these influences and coupled with the historic National Curriculum Conference held in 1969 spurred various bodies including government agencies to develop science curricula for both primary and secondary levels of education.

SELF-ASSESSMENT EXERCISE 1

List some of the primary science curriculum projects development in Nigeria till date

Notable among the developed primary science projects are:

- University of Nigeria Primary Science Pilot Scheme
- African Primary Science Project
- Bendel State of Nigeria Primary Science Project
- Ife Six Year Yoruba Primary Science Project
- The Primary Education Improvement Project
- Ondo State Primary Science Project
- National Primary School Science Project
- Basic Science and Technology Programme

3.1.1 University of Nigeria

This is the first Primary Science Curriculum project in Nigeria developed at University of Nigeria, Nsukka in the then Eastern part of Nigeria as a pilot scheme in 1963. The scheme was jointly sponsored by the Faculty of Education, University of Nigeria, Nsukka and the Ford Foundation. The focus of the scheme was on local materials and improvised equipment such as the use of jam-jars, bamboo microscope, bamboo cages and so on in teaching of primary science. The essence of using local material was to provide materials for teaching primary science as well as to integrate science to the local materials within the environment of the learner, to remove the abstract nature of science

from the early learners. The project placed emphasis on pupils' practical activities.

3.1.2: The African Primary Science Project (APSP)

APSP is one of the earliest curriculum innovative project in science at primary school level. It was launched in Kano in January 1965. The project was sponsored materially and financially by United States Agency for International Development (USAID), Ford Foundation of America and the Education Development Centre (EDC) of Massachusetts. The programme was later referred to as the Science Education Project of Africa (SEPA)

SELF-ASSESSMENT EXERCISE 2

What is the main focus of SEPA?
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. APSP with headquarters in Accra in 1965 to 1970 provided copies of printed materials consisting of pupils' textbook to Nigeria and teachers' guide and films which were distributed to schools mostly in Lagos. Also printed and provided was the Child Observation Checklist used in the evaluation of child learning.

3.1.3: Bendel State Primary Science Project (BPSP)

The BPSP which started in Benin city in 1966 was first called Mid-Western State Primary Science Project and later became known as the Bendel State Primary Science Project. The project was directed by the State Ministry of Education. It was jointly financed by United Nations Educational Scientific and Cultural Organization(UNESCO), United Nations Children's Fund (UNICEF)United Nations Development Programme (UNDP) and the Government of the former Mid-western State of Nigeria.

SELF-ASSESSMENT EXERCISE 3

What is the focus of BPSP?
The general purpose of the project is the development of primary science curriculum and the training of teachers to teach primary science. The project was designed to be child-centered with the aims of developing in the child the mind of inquiry, self-confidence and self-reliance through problem solving. In 1970 series of pupils' textbooks called Science Discovery together with the Teacher's Guide were produced.

3.1.4: Ife Six Years Yoruba Language Science Project

The project was part of an enlarged Ife Six Years Yoruba Primary Project initiated in 1970 at the University of Ife under the chairmanship of Prof. Babatunde Fafunwa. The overall objectives of this project were:

- To develop a primary education curriculum with a strong value since primary education is the terminal for many Nigerian children.
- To develop materials together with appropriate methodology for teaching the prepared curriculum effectively
- To use Yoruba language as the medium of instruction throughout, I order to demonstrate that the primary instruction when given in the child's mother tongue is more effective meaningful than using second or foreign language.

Other objectives of the project were:

- To organize writing workshop for the development and evaluation of curriculum materials
- To develop materials with appropriate methodology for teaching and learning the prepared curriculum
- Curriculum materials were to be developed in both Yoruba and English.

The project was supported financially by the Ford Foundation of America and former Western State Ministry of Education. The main objective of the project by the initiator was to develop a primary education for the child and make him/her an intelligent citizen of this country. The group set up a lexical Committee to select the right choice of words and concepts that would correctly express in Yoruba the concepts not easily identifiable with local language. The generally project was to exploit the use of mother tongue (Yoruba) in the teaching and learning of primary school subjects.

SELF-ASSESSMENT EXERCISE 4

Mention the materials produced to execute this project.
The materials produced are Sayensi for primary classes books from 1 to 6 both teachers' guide and pupils' text. The teachers' manual was also produced.

3.1.5: The Primary Education Improvement Project (PEIP)

PEIP was initiated in 1970 at the Institute of Education, Ahmadu Bello University, Zaria. The project was jointly sponsored and financed by the then six Northern State of Nigeria, UNESCO, UNICEF, USAID and British Council. The project was formerly called UNICEF/UNESCO assisted project but later called PEIP.

SELF-ASSESSMENT EXERCISE 5

What are the objectives of this project?

The project is aimed at making children think and study science like the scientists, hence it adopted the philosophy of American Association for the Advancement of Science (AAAS) process and skills with emphasis on the process of science such as observing, measuring, classifying, using numbers, manipulating, communicating and so on. The curriculum materials produced for the project were series of pupils' textbooks 1 to 6, workbooks and teachers' guide which provide detailed information for the teacher to carryout science activities specified in the pupils' text.

3.1.6: Ondo State Primary Science Project

The project was initiated in 1974 by former Western State of Nigeria but later continued in Ondo State after the creation of the state in 1976. The project drew its inspiration from the outcome of the APSP workshop.

SELF-ASSESSMENT EXERCISE 6

What is the purpose of the project?
The main purpose for the project was to produce a child-centered curriculum with an investigative approach. The curriculum materials produced for the project were pupils' textbooks and teachers guide. The teachers' guide was not completed for all classes before the creation of the state in 1976.

3.1.7: Basic Science and Technology Education Programme

The most recent innovative project in primary science in Nigeria is the Basic Science and Technology education programme. The Universal Basic Education (UBE) was introduced in Nigeria in September, 1988. Following this, in 2008 the Federal Government of Nigeria through the Nigerian Educational Research and Development Council (NERDC) developed and introduced the 9-Year Basic Education Curriculum (BEC) in schools by realigning all extant Primary and Junior Secondary School Curricula to meet the key targets of the UBE programme. In view of some contemporary and national concerns and to make the curriculum more practical, relevant interest generating to the young learners and in line with global best practices, the 9-year BEC was recently revised in 2012 and its implementation has just commenced in September 2014. One of the key components of Basic Education Curriculum was Basic Science and Technology prepared with the aim of catching the young learner early to love science, learn science and create change in the learners environment. It is a 9 years programme comprises of 3 years of Early Childhood Care Development and Education (ECCEDE), 6 years of Primary and 3 years of Junior secondary school. It also covers special interventions directed at nomadic and migrant children, mass literacy as well as the almajiris and other vulnerable and excluded groups. The main agencies coordinating the programmes of BST` is the Universal Basic Education (UBEC), National Commission for Nomadic

Education(NCNE) and National Mass Education Commission (NMEC). The Education National Minimum Standard and Establishment of Institutions Act 16 of 1985, together with the 1999 Constitution empowered the Ministry of Education to ensure a uniform standard of educational provisions in school and colleges. In view of the foregoing, the document charts the strategies and road-map for the education sector for the achievement of the goals of Vision 20-2020, 7-Point Agenda, National Economic Empowerment and Development Strategy II (NEED II) and Millennium Development Goals (MDGs) resulted to the reform of educational system that gave rise the basic science and technology education in primary and secondary level of education in the country.

SELF-ASSESSMENT EXERCISE 7

What are the central objectives of basic science and technology programme?

The central objectives were to provide uniform standard basic science and technology education to Nigerian children irrespective of gender, location and physical attributes for Nigeria's achievement of Vision 20-2020, NEED and MGOs.

4.0: CONCLUSION

The unit examined the details of the science curriculum innovative projects undertaken at the primary school level in Nigeria.

5.0: SUMMARY

In this unit you learnt that:

External influences and foreign curricula motivated many of the curriculum innovations in science at basic science education program in primary and junior secondary school level. Notable among the developed primary science projects in Nigeria are:

- University of Nigeria Primary Science Pilot Scheme
- African Primary Science Project
- Bendel State Primary Science Project
- Ife Six Year Yoruba Language Primary Science Project
- The Primary Education Improvement Project
- Ondo State Primary Science Project
- National Primary School Science Project
- Basic Science and Technology Curriculum

6.0: TUTOR-MARKED ASSIGNMENT

Discuss the common phenomenon in all the primary science projects mentioned in this unit.

7.0: REFERENCES/FURTHER READING

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UNIT 3: SCIENCE EDUCATION CURRICULUM DEVELOPMENT IN NIGERIA 2

1.0: INTRODUCTION

The content of science curriculum existing in our secondary schools before independent in 1960 was not the type that can provide enough learning experience for students to become useful to the society. The curriculum was intended for Cambridge University by West African Examination Council (WAEC) and was designed partially to satisfy the requirement of its external examination in science. The poor state of the type of curriculum in the science gave a lot of concern to Science Teachers Association of Nigeria (STAN) and WAEC in 1968 who jointly examined and revised the existing syllabi in science.

Efforts made by the following curriculum agents such as STAN, WAEC, NERDC (National Educational Research and Development Council) and CESAC (Comparative Education Study and Adaptation Centre) resulted in the following science curriculum projects undertaken at the secondary school level. This unit focuses on the following secondary school curriculum projects:

- The Basic Science for Nigerian Secondary Schools (BSNSS)
- The Nigerian Integrated Science Project (NISP)
- The Nigerian Secondary School Science Project (NSSSP)
- The National Science Curriculum for Secondary Schools

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Describe the philosophy and objectives of the projects
- Mention the organization that financed each project
- Mention the materials produced for execution of the projects

3.0: MAIN CONTENT

3.1: Basic Science for Nigerian Secondary Schools (BSNSS)

BSNSS was the first science curriculum development project undertaken in Nigeria between 1963-1967 at the Comprehensive High School, Ayetoro popularly known as Ayetoro project. It was financed by Ford Foundation of America and the Western Nigeria Regional Government and coordinated by CESAC of the University of Lagos.

SELF-ASSESSMENT EXERCISE 1

What approaches are adopted in implementing the project and the philosophy of the project?

BSNSS was a curriculum in general science which covered the first and second year of secondary school. It was written by Nigerians and was published in 1967 with its Teachers Guide. The syllabus was conceived to be child-centered with emphasis on the discovery teaching and laboratory-oriented activities.

The philosophy of the project is " Doing science the way scientists do it", observing carefully, reporting honestly what is observed and being patient. The underlying theme of the project is energy transfer- how energy is acquired, supplied and transferred between living organism and their surroundings. The content of materials for the project were divided into two main blocks. Block 1 for Form One and Block 2 for Form TWO. Block 1 contains five units while Blok 2 contains four units. The project was not widely adopted in schools as it did not go beyond the pilot-testing stage**.**

3.2: The Nigerian Integrated Science Project.

This was the first science curriculum project developed by STAN in 1970.

SELF-ASSESSMENT EXERCISE 2

What are the skills the project expected students to acquire in Integrated Science?

The expected skills for students to acquire after exposure to the course in Integrated Science are observing, measuring, classifying, reporting, organizing, generalizing, predicting and experimenting.

SELF-ASSESSMENT EXERCISE 3

What are the approaches and philosophy of NISP?

STAN commissioned its members to write Pupils' Textbook and Teachers Guide with emphasis on the child-centered approach. The philosophy of NISP was to assist the child to:

- Gain the concept of the fundamental unity of science
- Understand the commonality of approach to problem of a scientific nature
- Understand the role and function of science in everyday life and the world in which we live.

NISP consisted of six units arranged as follows:

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

3.3: The National Science Curriculum for Secondary Schools

The advent of the new 6-3-3-4 system of education in Nigeria brought about new curriculum in every subject area for both junior and senior secondary school levels of education. In science subjects namely chemistry, physics, biology new curricula were developed which was referred to as National Science Curriculum for Senior Secondary Schools.

SELF-ASSESSMENT EXERCISE 4

What brought about the new project NSSSP?

The critique of the draft copy of Nigerian Secondary School Science Project (NSSSP) submitted to the joint Consultative Committee on Education (JCCE) by CESAC resulted to the birth of National Science Curriculum for senior secondary. This new science curriculum adopted the spiral approach to the teaching of the concepts through guided discovery method.

4.0: CONCLUSION

This unit examined some science curriculum innovative project undertaken at secondary school level in Nigeria.

5.0: SUMMARY

In this unit you have learnt that:

- Basic Science for Nigeria Secondary School was the first pioneering science curriculum project undertaken in Nigeria at Comprehensive Secondary School, Ayetoro
- Nigerian Integrated Science Project (NISP) was the first science curriculum project developed by STAN in 1970.
- National Science Curriculum for Senior Secondary Schools came into being as a result of the new education policy called 6-3-3-4 system in Nigeria.

6.0: TUTOR-MARKED ASSIGNMENT

Outline the topics in STAN NISP Book and describe the arrangement of the units.

7.0: REFERENCES/FURTHER READINGS

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UNIT 4. HISTORICAL DEVELOPMENT OF INTEGRATED SCIENCE IN NIGERIA

1.0: INTRODUTION

The concern of this unit is to examine the background of the development of integrated science teaching, trace the changes in the objectives of science education that have occurred throughout the period and examine the threads of continuity which may be revealed in Integrated Science programme reforms both within and outside Nigeria that brought about integrated science in the Nigerian education system. The historical development of integrated science across the globe will focus on the following:

- Development of Specific Science Curricula (1870-1900)
- The Nature Study Movement (1890-1920)
- Recent Trends (1910 to Present)

2.0: OBJECTIVES

After studying the unit, you should be able to:

- Discuss the historical development of integrated science
- List all the integrated science projects embarked upon in Nigeria till the present day
- Discuss the genesis of transforming from General Science to Integrated Science and to the present-day Basic Science and Technology.

3.0: MAIN CONTENT

3.1: Development of Specific Science Curricula from 1870-1900

Many years before the 19^{th} century witnessed increasing demand for basic school science. Varied factors of social and economic development during the time contributed to this increasing demand of science such as:

- The rapid development of science and technology in Europe and America and their application to industry and everyday life.
- Influence of laboratory method in technology
- Increasing demand for skilled labour to man developed industries
- Emergence of a new philosophy of education that emphasized pupils' activity as a natural expression of biological development.

SELF-ASSESSMENT EXERCISE1

Discuss the emergence social and economic benefits of the 18^{th} and 19^{th} centuries.

During these periods special interest group developed attention to schools. The primary objectives of science programmes were first-hand observation and

experience. Experimentation and problem-solving types of teaching were just beginning to be considered as significant scientific techniques. Due to lack of teachers the proposed elementary science could not introduce the practice.

3.2: Nature Study Movement of 19th Century

This period witnessed great enthusiasm towards nature from science educators across Europe, America and Africa that geared towards introducing the programme in schools. The main purpose of the movement was to improve agriculture and toovercome the desire of farmers' children from leaving the farm for the city.

SELF-ASSESSMENT EXERCISE 2

Down the memory lane when Nature Study was offered in the school, could you remember some of the objectives of the subject? Mention them.
The objectives of Nature Study focused on the learning of facts for their own sake. It also emphasized the aesthetic and moral learning that might be derived from scientific observation. Nature study embraced the natural and physical sciences but their subject matters were limited to biological science. This was because those who were interested in introducing nature study in schools were specialists in the biological sciences. In parts of Africa, America and Europe nature study still form part of school curriculum but with different names such as general science, rural science, hygiene depending on the country.

3.3: Recent Trends after Nigerian Independent

In the past four decades, there have been changes in the nature of science taught in schools. For instance, science had become more integrated and emphases have been on the products (that is concepts, laws and theories) and the processes of science which students were both to understand and frequently perform. The decades of 1960's was marked by the initiation and development of a number of school science curriculum projects that were designed to improve science programme.

SELF-ASSESSMENT EXERCISE 3

Examine the primary and secondary school science curriculum projects embarked upon in Nigeria after independent.
After the 1969 curriculum summit, several primary and secondary school science projects **were embarked upon by the government to improve science education in Nigeria**. The following projects such as the African Primary Science Programme (APSP), Bendel Primary Science Project (BPSP), Primary Education Improvement Project(PEIP), Project for Six Northern States, Ife Six-Year Primary Science Project and National Primary Science Project (NPSP)

were embarked upon in the early 1970's. At secondary school level we have the Basic Science for Nigerian Secondary School (BSNSS) popularly known as Aiyetoro Science Project, Nigerian Integrated Science Project (NISP), Nigerian Secondary School Science Project (NSSSP), National Science Curriculum for Senior Secondary Schools and Basic Science and Technology Education. Details of all these projects have been discuss earlier under unit 2 of Module 1.

SELF-ASSESSMENT EXERCISE 4

What are the major criticisms of General Science that resulted to the changes in nomenclature to integrated science and presently basic science and technology education?

In many countries of the world today, science courses were expected to cover the whole range of science in a balance way. Such courses were in a way coordinated survey of biology, chemistry and physics. Secondly, little real unity was observed in the presentation of the course. Thirdly, teachers could not achieve any real integration in their teaching. Fourthly, teacher training courses rarely prepare teachers for the unified approach to their teaching. Furthermore, General Science courses were regarded as too superficial, as an inadequate base from which to develop higher level science courses and generally little times were allocated to it by school authorities. Furthermore, the essence of teaching science at the primary and junior secondary school is to help them master the basic understanding of scientific concepts and cultivate the habit of exploring science with an open mind. The science topics taught at these levels are arranged into six strands of scientific investigation, life and living things, the material world, energy and change, earth and beyond, science, technology and society. Thus, it is renamed Basic Science and Technology in the new compensation.

SELF-ASSESSMENT EXERCISE 5

How is the concept of integration receiving attention in other subjects?

Integration of courses was not only in science though there has been an increasing interest in integrating separate sciences. Almost all areas of school curriculum were moving towards integration. The integration of geography, history, government to form social studies is a typical example of integration. Integration was in the mind of early curriculum planners as seen reflected in the science curriculum projects developed in the 1960's. For example, modern physics courses are no longer a mixture of light, heat and sound, dynamics, electricity and magnetism, physics itself is unified through major concepts. Biology is no longer divided into zoology and botany. In order words, integrated science teaching is one of the logical steps in our educational development.

4.0: CONCLUSION

This unit exposed you to the various historical development of science with particular reference to the threads of continuity from development of specific science curricula to nature study as beginning of science later to General Science to integrated science and finally Basic Science and Technology as we have it today.

5.0 SUMMARY

In this unit you learnt about the historical background of the development of integrated science from the development of specific science curriculum in before and after independent to the study of nature study movement and finally what is regarded recently trends from 1910 to present time. The recent trends include when science is being taught as General Science but later changed to Integrated Science and finally to Basic Science and Technology in this 21st century.

6.0 TUTOR-MARKED ASSIGNMENT

What are the problems and prospects of integration approach to the teaching of Basic Science and Technology.

7.0 REFERENCES/FURTHER READING

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UNIT 5: MEANING OF INTEGRATED SCIENCE

1.0: INTRODUCTION

In this unit, you will be introduced to various definitions of Integrated Science, the meaning of Integrated Science as related to science, characteristics of Integrated and Non-Integrated Science as well as factors that make Integrated Science education worthwhile in both developed and developing countries.

2.0: OBJECTIVES

After studying the unit, you should be able to:

- Define Integrated Science
- Explain the concept of Integration
- Discuss the characteristics of Integrated and Non-Integrated Science
- Mention the popularity factors of Integrated Science
- Explain the concept STEM the spirit of integration.

3.0: MAIN CONTENT

3.1: Meaning of Integrated Science

In a simple and general terms, Bajah (1983) sees integrated science as a way of teaching science. When science is taught in such a way as to present scientific ideas as a unified whole, then we say that the ideas have been integrated. Nagaraj (2013) defined integrated science as a holistic and constructive learning process in which the learner is whole involved.

SELF-ASSESSMENT EXERCISE 1

What will you consider as a classical definition of Integrated Science?
There are many classical definitions of Integrated Science which you can find in recent books. One of the definitions is given here for your consideration. Bajah (1983) defined Integrated Science as an approach to the teaching of science in which concepts and principles are presented so as to express the fundamental unity of scientific thought and avoid premature or under stress on the distinction between the various scientific fields. According to Nagaraj(2013) integrated science is a holistic and constructive learning process in which the learner is whole involved.

SELF-ASSESSMENT EXERCISE 2

Explain the different fields in the study of Science.
Six fields in the study of science are astronomy, biology, physics, chemistry, geology, zoology and so on. The approach to the investigation may of scientific

problem may demand knowledge of one or more fields of science. Using an approach therefore which does not emphasize the boundaries between the various fields of science is desirable in the study and teaching of Integrated science. Hence integrated science therefore stresses the fundamental unity of science. Ezeliora et al (2011) indicated the different branches of science as physics, biology, chemistry, astronomy, geology, zoology, botany and so on.

SELF-ASSESSMENT EXERCISE3

Mention some advantages of having Integrated Science in science education curriculum.

The advantages of having integrated science in science education curriculum of many countries at different levels include;

- It saves time, personnel and resources when duplications are limited
- The availability of scientific education for non- specialists
- The satisfaction of the needs of young learners whose logic differ from the logic of single subject disciplines.
- A more accurate picture of the process which constitute science
- Increased potential for problem solving.

SELF-ASSESSMENT EXERCISE 4

What are the difficulties the inclusion of Integrated Science in our school curriculum faced in the past?

Although Integrated Science has survived in our school curriculum, it has faced some serious problems in the past. One of the major problems is inadequate production of qualified teaching staff for the subject. Science teachers were traditionally trained in one or two of the science subjects. But the Integrated Science curricula for schools embrace biology, physics, chemistry, agriculture and earth science. Teachers therefore feel insecure to teach aspects of the curricula which are not familiar to them. In view of the above, an Integrated Science education degree for both serving and non-serving Nigerian Certificate of Education (NCE) Science teachers at various universities in Nigeria either on full time or sandwich basis was initiated.

3.2: The Concept of Integration

d'Arbon (1972) described Integration when applied to science courses means that the course is devised and presented in such a way that students gain the concept of the fundamental unity of science, the commonality of approach to problems of a scientific nature and are helped to gain an understanding of the role and function of science in every day life and the world in which they live. Nagaraj (2013) perceived integration as a holistic and constructive learning. In other words, integrating principles are intended to produce a course which:

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

SELF-ASSESSMENT EXERCISE5

Give examples of integrated disciplines.

There has been an increasing interest in integrating the separate sciences though move for integration is not confined to science subjects. Several areas of school curriculum are also moving towards integration. For instance, the integration of geography, history and others to form social studies, biology and chemistry to form biochemistry; geology and physics to form geo-physics and many others. Educators and scientists have joined forces to produce programmes such as the Biological Sciences Curriculum Study (BSCS) Chemical Bond Approach (CBA) and CHEM Study Programme in chemistry, physical science study programme. These programmes demonstrate how science disciplines may be represented in different ways, each project lending itself to some form of interdisciplinary or integrated approach.

The Basic Science and Technology curriculum that was revised in 2012 is the result of the restructuring and integration of four primary and junior secondary science curriculum. The following science subjects were integrated into one:

- Basic science
- Basic Technology
- Physical education and health
- Information Technology

This became necessary in order to reduce the number of subjects offered in primary and junior secondary schools, to prevent repetition and duplication of concepts that resulted in curriculum overload, to encourage innovative teaching and learning approaches and techniques that promote creativity and critical thinking in students, to promote holistic view of science at all level for better understanding of a contemporary and changing world and to infuse emergent issues that are of national and global concern such as gender sensitivity, globalization and entrepreneurship into the curriculum.

SELF-ASSESSMENT EXERCISE 6

What are the characteristics of Integrated Science?

A critical examination at Integrated Science requires a concise description of its unique aspects in order to clarify how integrated science differs from other curricula arrangement. In Integrated Science, traditional subjects matter boundaries are completely removed but in biology, chemistry or physics individual identity are visible. In Integrated Science course is organized around a selected unifying topic. The course usually serves a general education

function. The sequence arrangement of topics tries as much as possible to avoid duplication of content. The course usually lasts for three years and is sequential. It is evidence from above that Integrated Science emphasizes organization of learning experiences around a topic or theme. This unification of concepts around a theme makes integrated science unique. For example in some the learning experiences and concepts of integrated science are organized around the themes Energy, Life and Mind while in some other integrated science programme the concepts are organized around the themes" Matter, Life, Mind and Society.

SELF-ASSESSMENT EXERCISE 7

What is the merit of organizing concepts around themes?
Organising concepts around themes is a good way of deliberately removing the subject matter boundaries. The main criticism against the current integrated science programmes in Nigeria is the fact that the various subject disciplines biology, chemistry and physics are evident in the various units.

3.3: STEM (science, technology, engineering and mathematics): Translation of Integration

STEM is an interrelated and interwoven bundle of knowledge that forms the ingredients for technological breakthrough. It is a typical example of integration (Ezeliora, 2016). For instance, science studies the flow of electronics in electrical conductors by using already existing tools and knowledge. This new found knowledge is used by engineers to create new tools and machines such as semiconductors, computers and other forms of advanced technology. In this sense both scientists and engineers are considered technologist. According to Rugumayo in Ezeliora (1997) STEM education builds in individual in varying proportions the scientist who explores what is, the engineer who creates what has not existed before and the technologist who translates ideas and plans into working realities aware of his/her responsibility and duties towards the society. STEM education brings about the integration of ideals that gives rise to new products. According to Ezeliora (2016) STEM is atypical process of integration of scientific ideas to yield the expected result for human development.

SELF-ASSESSMENT EXERCISE2

Examine the relationship between Integrated Science and STEM?

Integrate science provides the learner unified knowledge that will empowers him/her to make, create, innovate and invent. There is a trend towards greater social relevance in integrated science courses and STEM. Both bring about the integration of ideas that leads to development. According to Ezeliora (2016) in STEM science, technology, engineering and mathematics

are interwoven and interrelated and generate products and translate ideas and plans in working realities. In integrated science students are taught the interrelationship in science, technology, engineering and mathematics. In other words, integrated science should develop in the students the integrated nature of science.

4.0: CONCLUSION

This unit exposed you to the meaning of integrated science as well as the various positions so far taken in integration in science in an attempt to explain the fundamental unit of science and their applications

5.0: SUMMARY:

In this unit, we have learnt that there are many classical definition of integrated science one of which was given by Bajah (1983). d'Arbon (1972)and Nagaraj (2013) further explained the concept of integration in science to mean the course should be devised and presented to reflect the concept of fundamental unity of science. The unit also discussed the characteristics of acceptability of integrated science and the favours that make integrated science education worthwhile as reflected in the new Basic Science and Technology curriculum recently in use in the basic introduction of science to young learners. STEM is shown to be typical application of integration which later will result to technological development which is the main goal of integration in science.

6.0: TUTOR-MARKED ASSIGNMENT

Advance reasons for the universal acceptability of integration of science in spite of the skeptical views being expressed by subject specialists.

7.0: REFERENCES/FURTHER READING

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MODULE 2: PHILOSOPHY AND PSYCHOLOGICAL THEORIES OF INTEGRATED SCIENCE

Unit 1: Philosophy and Objectives of Integrated Science
Unit 2: Psychological Theories of learning and their applications in teaching basic science and technology
Unit 3: Psychological Theories of learning and their applications in teaching basic science and technology
Unit 4: Methods of Teaching Integrated Science
Unit 5:Resources for Teaching Integrated Science

INTRODUCTION

The concern of this module is to expose you to the philosophy and objectives of integrated science as well as the psychological theories of learning and their applications in the teaching and learning of basic science and technology in the primary and junior secondary schools. Other issues to be discussed in this module include teaching methods that can be applied in achieving integration of science at the primary and junior secondary schools as well as resources for teaching basic science and technology in primary and junior secondary schools. The module will also introduce you to the process of improvisation. The module is divided into five units:

Unit 1: Philosophy and Objectives of Integrated Science
Unit 2: Psychological Theories and their application in teaching basic science and technology
Unit 3: Psychological Theories of learning and their applications in teaching basic science and technology
Unit 4: Methods of Teaching Integrated Science
Unit 5: Resources for Teaching Integrated Science

UNIT 1: PHILOSOPHY AND OBJECTIVES OF INTEGRATED Basic Science and Technology

1.0 INTRODUCTION

You have in previous units examine the various positions so far taken in integration in science as an attempt to explain the meaning and partly philosophy of integrated science. This unit will therefore be a continuation of the philosophy and objectives and development of basic science and technology that is currently in use in primary and junior secondary levels. The focus of the entire unit shall be on integration as a new strategy, objectives of Basic science and technology in Nigeria.

2.0 OBJECTIVES

After studying the unit, you should be able to

- Articulate the philosophy of basic science and technology curriculum
- State the objectives of basic science and technology curriculum

3.0: MAIN CONTENT

3.1: Integration as a new strategy

When specialist teacher is confronted with the teaching of integrated science, there is always the evidence of bias towards their own special discipline. For example, chemistry teacher treats the chemistry section of the integrated science well than other sections on biology and physics. This same mode of treatment of topics is equally true about physics and biology teacher. As a result of the above, there is need for an entirely new philosophy and approach to integrated science.

SELF-ASSESSMENT EXERCISE 1
How is the spirit of integration established?

Although the meaning of integration is clearly defined and understood, there is need to devise a means by which the spirit of integration can be practicalised in the classroom. Integration is as practical as it sounds not just a theory. Bajah (1981) proposed four modules to achieve integration of science. In the modules his focus on integration of science is by organizing learning experiences around theme rather than putting together subject matters from a definite discipline.

Based on the unifying theme of life, energy, matter and society he was able to build up four modules from the general theme. The basic science and technology that was revised in 2012 is the result of the restructuring and integration of four primary and junior secondary science curricula. The following science subjects were integrated into one:

- Basic science
- Basic technology
- Physical education and health
- Information technology

This becomes necessary in order to reduce the number of subjects offered in primary and junior secondary schools, to prevent repetition and duplication of concepts that resulted in curriculum overload, to encourage innovative teaching and learning approaches and techniques that promote creativity and critical thinking in students, to promote the holistic view of science at this level for better understanding of a contemporary and changing world and to infuse emergent issues that are of national and global concern such as gender sensitivity, globalization and entrepreneurship into the curricula. Each of this is further developed further into modules:

BASIC SCIENCE:

Theme 1 Leaning about our environment
Theme 2 You and energy
Theme 3 Science development

BASIC TECHNOLOGY
Theme 9 Materials and processing
Theme 10 Drawing practice

INFORMATION TECHNOLOGY
Theme 11 Basic computer
Theme 12 Basic knowledge of information technology
Theme 13 Computer application package**s**

SELF-ASSESSMENT EXERCISE 2

What is a module?

Module is each of a set of standardized parts of independent units that can be used to construct a more complex structure, such as an item of furniture or a building. According to Cambridge University dictionary (2020) module is of a set of separate parts that when combined, form a complete whole. This definition brings out clearly why modules are used in organizing course contents in integrated science. Modules are used to organize course content by weeks, units or a different organizational structure. A module according to Bajah (1981) is a learning package. It is an interplay of ideas from biology, chemistry and physics relating to the central theme. One significant feature of module is that each module as you will see is not too long, will deal with theme which can then have other sub-concepts. Any teacher who takes up a module will find it hard to isolate certain areas as belonging to some subject disciplines because the central theme will always remain. Thus the four modules developed by Bajah (1981) were based on the following module: Life, Energy, Matter and Society. In the new basic science curriculum there are six modules or themes namely:

- Scientific Investigation
- Life and Living Things
- Material World
- Energy and Change
- Earth and Beyond
- Science, Technology and Society

3.2.: Objectives of Integrated Science in Nigeria

Objectives of integrated science in Nigeria are based on the relevant portions of the National Policy on Education as they relate to science education in general and to integration of science in particular. Government plans that the period for basic science and technology should be 9 years, 6 years primary level and 3 years junior secondary level. They will both be academic and pre-vocational. It will be free as soon as possible and will teach all basic subjects which will enable pupils and students to acquire further knowledge and develop skills. Students leaving school at the junior secondary school stage may then go on to an apprenticeship system or other scheme for out-of-school vocational training.

SELF-ASSESSMENT EXERCISE 3

Articulate the importance of integration of science in the scientific development students.

Whatever science programme is developed for the primary and junior secondary school students must take into consideration the specific national education objectives which emphasized flexibility of the science programme such that it can be applicable to all parts of the country and for considerable length of time. Based on the above guiding principles the essence of an integration of science course is to teach the students and pupils what science is, how a scientist works and its application to the environment. As a result, the objectives of integrated science are aimed at enabling the students and pupils who are exposed to it acquire the following skills:

- Observing carefully and thoroughly
- Reporting completely and accurately what is observed
- Organizing information acquired
- acquired information
- Predicting as a result of the generalizations
- Designing experiments to check predictions
- Using models to explain phenomena where appropriate
- Continuing the process of inquiry when new data do not conform to prediction

The main objectives of Basic Science and Technology (BST) are to prepare the students to:

- Develop interest in science and technology
- Acquire basic knowledge and skills in science and technology
- Apply scientific and technological knowledge to meet contemporary social needs.
- Take advantage of the numerous career opportunities provided by science and technology
- Become prepared for further studies in science and technology.

FGN (2009) stated that the major issues shaping contemporary growth and development of nations and influencing knowledge driven societies such as

those listed above were identified and infused into the BST curriculum content at every level such as:

- Environmental education
- Climate change
- Drug abuse education
- Foods and drug safety education
- Disaster risk reduction education
- Consumer education
- Safety and security
- Entrepreneurship education

5.0: SUMMARY

In this unit, you learnt about the followings:

- Four modules proposed by Bajah (1981) Life, Energy, Matter and Society from which basic science and technology was built with some other themes of national and international interest
- The new modules as contained in the basic science and technology curriculum.
- Meaning of modules as a learning package
- The philosophy and objectives of basic science and technology Education

6.0: TUTOR-ASSESSMENT EXERCISE

How has the arrangement of basic science and technology curriculum reflected integration and module set up?

7.0: REFERENCE/FURTHER READING

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UNIT 2: PSYCHOLOGICAL THEORIES OF LEARNING AND THEIR IMPLICATIONS TO LEARNING BASIC SCIENCE 1

1.0: INTRODUCTION

Humans generally have patterns of thinking. How do these expand to include new ones and how concepts is formed in the human beings are questions to address. Various cognitive psychologists

Such as David Ausubel, Jerome Brunner, Robert Gagne, Jean Piaget and many others have provided answers to these questions on how human learns. Answers to these questions carry very large consequences for the organization of science lessons.

2.0 OBJECTIVES

After studying this unit, you will be able to:

- Describe David Ausubel's Theory of Learning
- Discuss the Implications of the Theory to Science Teaching and curriculum development
- Describe Jerome Brunner's Theory of Learning.
- Discuss the implication of the theory to Science Teaching and curriculum development

3.0 MAIN CONTENTS

3.1: David Ausubel's Theory of Learning

Ausubel's theory of learning distinguishes between rote and meaningful learning and how prior knowledge affects learning process (Ausubel,1960). He stresses the value of prior knowledge in students' learning. He is of the opinion that what a student already knows could aid or hinder new learning. He pointed out that meaningful learning occurs when there is appropriate link between prior knowledge and new learning task. When there is no such interaction, rote learning occurs.

SELF-ASSESSMENT EXERCISE 1

What is the meaning of Subsumer?

Subsumers are those parts of the learner's cognitive structure which provide interaction necessary for meaningful learning. According to Ausubel (1960) subsumer is a principle or generalized body of knowledge that the learner already acquired that can provide for association or anchorage for the various components of the new knowledge. It is the linkage between the new knowledge and existing knowledge to create meaning. Another link relevant to meaningful knowledge is advance organiser for in the absence of subsumer, it links new material with the previous knowledge.

SELF-ASSESSENT EXERCISE 2

What is Advance Organiser?

Ausubel advocates for introduction of what he called advance organizer as alternative to subsume incase it is lacking in the learner. Ausubel (1960) noted that advance organiserhelp in the process of meaningful learning and retention. Advance organisers are set of link or anchorage between the new and existing knowledge. Ausubel proposed that learning can take place into two processes:

- The use of relevant subsume when they exist in the knowledge already possessed by the learner.
- The use of advance organizer where the subsume is absent.

3. 1.1. Implications of Ausubel Theory of Learning for Teaching Science and Curriculum Development.

- **Teaching** of science subject must not begin until the teacher is sure of the previous knowledge and if not the teacher should provide.
- Teaching of science subjects must begin with new learning or knowledge in a sequential manner.
- Science teacher must not present new materials during teaching unless the learner is ready.
- Ausubel supported the use of expository method in teaching of science subjects as the method can lead to high level of understanding and generally as against the use of discovery approaches which are extremely time consuming.
- Contents in the curriculum must be arranged in sequential order.

SELF-ASSESSMENT EXERCISE 3

What is Discovery?

3. 2: Jerome Brunner's Theory of Learning

Jerome Brunner introduced the concept of learning by discovery. Discovery is an all forms of obtaining knowledge for oneself by use of one's mental processes. Brunner believed that learning by discovery begins when a science teacher purposefully creates problem and present the problem to students by introducing some inconsistencies among sources of information which are given in the process of instruction. According to Brunner such inconsistencies lead to intellectual discomfort that will stimulate the students to initiate individual discoveries through cognitive restructuring.

SELF-ASSESSMENT EXERCISE 4

How many forms of Discovery Processes exist according to Brunner?

According to Brunner (1960) two forms discovery processes exist:

- Assimilation: This occurs when a student spontaneously recognizes a new situation that is familiar to the one of the elements in his existing structure of knowledge and easily assimilates it.
- Accommodation: This occurs when a new situation is incompatible to the existing structure of knowledge. The teacher first structures his cognitive framework in order to be able to accommodate the new knowledge.

SELF-ASSESSMENT EXERCISE 5

Name the Three Types of Human Activities for Learning which Brunner's Theory emphasized.

Brunner's theory of learning emphasizes that the student should find out information on their own through the use of mental processes. It also placed great importance on the three types of human activities for learning namely:

(i) Physical activity referred to as Enactive representation
(ii) Imagery referred to as Ionic representation
(iii) Symbolic activities

These three activities coexist with each other and for this reason the attainment of one does not mean the total abandonment of the others.

SELF-ASSESSMENT EXERCISE 6

List the activities that accompany each of the three information processing systems.

The three activities include:

- At enactive stage: The child manipulates the learning materials directly by neuro-muscular activities
- At ionic stage: The child deals with mental images of objects but could not manipulate the objects directly
- At symbolic stage: The child uses language to express the objects.

The interpretation of these three stages together is that when a child in junior secondary level shows deficiencies in his learning capacity especially in symbolic representation, it could be that such a child was deficient at the two earlier stages which he/she skipped. It is therefore compulsory to fill in the skipped gap by providing concrete support that will make up for the deficiency.

3. 2.1: Implications of Jerome Brunner's Theory of Learning and Curriculum Development

- Science teachers should place emphasis on the important of ideas and relationships of subjects that will allow students generate new concepts, ideas, relationship and principles.
- Science teacher should create problems that can lead to discomfort that will result to students initiating individual discoveries through cognitive structuring.
- Science teacher should encourage discovery learning to aid problem solving and develop creativity in the students.
- Science teacher should encourage students to make intuitive guesses. This will help students a chance to practice their ability beyond the information data.
- Students should be taught inductive approach
- Radical re-organisation of science curriculum across all levels of all the subjects the student will study are presented in a very simple form.

4. 0: CONCLUSION

The importance of psychological theories of learning to both science teachers and students are obvious. In the light of this, the study and application of the two theories discussed in this unit should be intensified

5.0: SUMMARY

In this unit, you have learnt that:
David Ausubel's theory of learning stresses:

- The value of prior knowledge
- That meaningful learning takes place when there is appropriate link between prior knowledge and new learning task.
- Sequence of instruction is very essential.

Jerome Brunner theory of learning centers on:

- Learning through discovery
- Discovery aids problem-solving and creativity development
- Two forms of discovery namely assimilation and accommodation characterized Brunner's theory
- Three types of human activity for learning namely
  (i) Enactive representation
  (ii) Ionic representation
  (iii) Symbolic representation

Are the essential ingredients for Brunner's theory of learning

6. 0: TUTOR-MARKED ASSIGNMENT

Discuss how you as a science teacher will apply Brunner's ideas in the teaching of basic science and technology in the classroom.

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UNIT 3: PSYCHOLOGICAL THEORIES OF LEARNING AND THEIR IMPLICATIONS FOR TEACHING SCIENCE AND CURRICULUM DEVELOPMENT 11

CONTENT

1.0: INTRODUCTION

In the previous unit you studied two cognitive psychologists whose works have tremendous impact on teaching /learning process. These two and other psychological theories you will learn in this unit are very important and relevant because they are fundamental theoretical foundations for the resent instructional strategies in the teaching and learning processes. In this unit, you will learn about two other cognitive psychologists Robert Gagne and Jean Piaget as well as their general implications for science teaching and science curriculum development.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Describe Robert Gagne's theory of learning

- Discuss the implication of the theory to science teaching and curriculum development
- Describe Jean Piaget's theory of learning
- Discuss its implications to science teaching and curriculum development.

3.0: MAIN CONTENT

3.1: Robert Gagne's Theory of Learning

Robert Gagne's theory of learning often referred to as Gagne's theory of learning hierarchy. The theory states that learning of a new concept or skill depends upon the mastery of pre-requisite concepts. This implies that previous knowledge determines what further learning may take place and that materials meant for learning must be sequentially structured. Gagne emphasized the importance of task analysis of instructional objectives. He also believes in the task analysis of the concepts, skills and knowledge to be taught.

SELF-ASSESSMENT EXERCISES 1

Name the highest level of Gagne's learning hierarchy

Gagne's theory believes that for the students to acquire the desired knowledge, the materials meant for learning must be sequentially structures so that the learning of one topic aids the learning of the next higher topic. This invariably implies that learning of science must be sequentially structures from simple to complex until the desired objectives are achieved. In Gagne's hierarchy of learning problem solving is the highest level while facts, concepts and generalization involved lower level.

SELF-ASSESSMENT EXERCISE 2

What is the importance of pre-testing in the teaching/learning process?

Gagne's theory advocates the administration and use of pre-test to find whether the students possess the relevant pre-requisite for the next knowledge (Akambi, 2000). The result of pre-test will help the teacher to know the entry point for teaching/learning process. Gagne suggested that teachers should ask questions such as What he/she wants the students to learn. The answer to thee questions should from the statement of the objectives which are usually stated in behavioural form.

3.1.1: IMPLICATIONS OF GAGNE'S THEORY FOR SCIENCE TEACHING AND CURRICULUM DEVELOPMENT.

- Content in science subjects must be should be arranged in hierarchical order such that simpler concepts are mastered first before the more complex concepts.
- Science teachers should state the objectives for learning any topic
- Learning should be arranged in sequence such that learning one topic should lead to learning of the next higher topic.
- Science curriculum contents should be arranged in hierarchical order such that simpler contents are treated first at lower class before complex contents in the higher class.

3.2: JEAN PIAGET'S THEORY OF LEARNING

Jean Piaget a developmental psychologist spear-headed the studies on cognitive and mental development. Piaget's theory emphasized that learning ability corresponds to the level if intellectual development.

SELF-ASSESSMENT EXERCISE 3

What are the developmental stages identified by Piaget?

The four human intellectual developmental stages identified by Piaget together with the approximate age to which they correspond are as follows:

- Sensory-motor stage 0-2 years
- Pre-operational stage 2-7 years
- Concrete operational stage 711 years
- Formal operational stage 11-15 years

3.2.1. SENSORY-MOTOR STAGE 0-2 YEARS

This stage can be thought of as a pre-verbal stage. The child's learning activities at this stage consists mainly of sensory and motor activities like seeing, sucking, tasting, touching, pushing and shaking the objects in his/her environment. The child learns also tat objects are permanent and go out of existence when they can no longer see them. The child's experiences during this period form the basis for the later knowledge. By the end of the period, certain aspects of the child's behavour can be called intelligent. She/he can pull a string to get an object. At this stage major intellectual activity is interaction of the senses and the environment.

3.2.2: PRE-OPERATIONAL STAGE 2-7 YEARS

SELF-ASSESSMENT EXERCISE 4

What is operation in Piaget's Theory of mental development?

The term operation in Piaget's theory is a way of thinking that follows a definite pattern. It is subconscious act of thinking which is pre-requisite to logical reasoning. Urevbu (1990) has it that until a child can think operationally she/he is unable to completely analyse or organize information presented to him/her.

SELF-ASSESSMENT EXERCISE 5

List the child's attributes at pre-operational stage.

At the pre-operational stage, the child may be able to speak clearly, use symbolic representations by drawing, writing and reading and perform complex physical manipulations. She/he is perceptually oriented but cannot reason logically or see contradictions that to an adult are glaringly obvious. The child also develops the idea of volume, height, length and number. She/he easily confuses the physical change of an object with the change in quantity of the object. For example, if the same volume of soft drink is poured into a different cups having different shapes narrow and wide. The child will see the soft drink in the narrow cup as a one more than the wide cup. This illustrates that the child has confused height with the volume. At this stage thinking of the child is irreversible. At this stage the child uses language by talking, questioning. Talking to self or objects is part of the characteristics of this stage.

3.2.3: CONCRETE OPERATION STAGE (7-11) YEARS

At this concrete operational stage, the child's mental process is limited to thinking about things. The child is able to solve problems but limited ability to do so by nature. The child cannot cope with problems where hypothetical situations must be considered. Solutions are achieved by trial and error. The child develops the ideas of conservation of matter, length, weight, volume and concepts of time and space.

SELF-ASSESSMENT EXERCISE 6

What are the implications of concrete operational stage?

At this stage the child performs logical operation with concrete objects. The child can carry out logical processes like observing, describing, classifying and measuring real objects. The implications of the stage are that it is a period of exploration. This implies that studying of science in primary school should begin with the art of observation which uses basic senses of seeing, smelling, hearing, touching and tasting. Greater emphasis should be placed on doing than telling. Teaching at this stage should involve the use of models- specimens, real objects because the child depends on facts and theories.

3.2.4: FORMAL OPERATIONAL STAGE 11-15 YEARS

SELF-ASSESSMENT EXERCISE 7

How does this stage relate to other earlier discussed stages?
Progression through the previous stages results in accumulation of experiences and development of mental structures which are necessary background for logical and pre-operational reasoning. This stage is characterised by freedom from reality. Reality provides starting point for thinking. At this stage the child develops abstract thinking. The child can follow logical arrangements. At this stage more complex relationship of mathematics and science and hypothetical deductive nature of reasoning can be fully understand. The child can make deductions, compares and make inferences from ideas, solve ideological problems and relate symbols to concepts.

3.2.5: IMPLICATIONS OF JEAN PIAGET'S THEORY OF LEARNING FOR SCIENCE TEACHING AND CURRICULUM DEVELOPMENT

- Science teacher should promote exploration and interaction with environment using locally available materials.
- Science teacher should ensure that the learner deals with concrete materials before going to complex, commencing teaching from simple to complex.
- Present new ideas and knowledge at the level consistent with the child's present state of development, thinking and language.
- Focus on problem solving rather than rote memorization

- Curriculum should be designed to reflect level of mental operation of students.

4.0 CONCLUSION

In this unit you have been exposed to two cognitive psychologists namely Robert Gagne and Jean Piaget. You have equally been exposed as a science teacher the implications of the two theories for teaching science and curriculum development.

5.0: SUMMARY

In this unit, you have learnt that:

- Robert Gagne's theory of learning states that learning of a new concepts or skills depends on mastery of pre-requisite concepts.
- Gagne believes materials for learning mustbe sequentially structured.

Implications of Gagne's theory for science teaching and curriculum development are:

- Contents in science should be arranged in hierarchical order
- Emphasize on stating objectives for learning science topics
- Emphasizes on pre-testing.

Jean Piaget's theory of learning emphasizes that learning ability corresponds to intellectual development. He identified four human intellectual developmental stages:

- Sensory-motor stage 0-2 years
- Pre-operational stage 2-7 years
- Concrete operational stage 7-11 years
- Formal operational stage 11-15 years

Implications:

- Local materials should be used to promote exploration and interaction with environment.
- Teaching are to commence from simple to complex
- Emphasis should be placed on problem solving rather than rote learning
- New ideas and knowledge must correspond to the level of child's development
- Science curriculum is designed to give the learner opportunity to perform desirable mental operation.

6.0: TUTOR-MARKED ASSIGNMENT

Discuss Piaget's general principles' application to teaching basic science and technology in the classroom.

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Unit 4: METHODS OF TEACHING BASIC SCIENCE AND TECHNOLOGY

CONTENTS

1.0: INTRODUCTION

Methods of teaching are the approaches or means adopted by the teacher to carry out the function of instructions. There are many approaches in practice which the Integrated Science teacher can apply to deliver instruction to early science learners. Such methods like lecture method, demonstration method, discussion method, project method, discovery method, laboratory method or investigative method but for integrated science the best method is student-centered approach where the teacher's primary role is to coach and facilitate student learning and overall comprehension of materials. Each method specifies the various activities to be carried out by both the teacher and the students in order to achieve the stated objectives of the lesson. Teaching methods are grouped into two namely teacher-centered approach and child-centered approach. According FGN (2009) learner-centered approach is advocated for the teaching of Basic Science and Technology programme in Nigeria. Though choice of teaching method depends on what fits teacher's educational philosophy, classroom demographic, subject area and the school mission statement.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- outline some teaching methods appropriate for teaching Basic Science and Technology
- explain the activities involved in each method
- state the advantages and disadvantages of each method.

- list factors to be considered in choosing methods of teaching
- Examine the use of ICT as a teaching tool

3.0: MAIN CONTENT

3.1: METHODS FOR TEACHING BASIC SCIENCE AND TECHNOLOGY

Method of teaching Basic Science and Technology as stipulated in the curriculum is guided inquiry and activity-based approach. The curriculum advocates for child-centered approach in the teaching of Basic Science and Technology.

SELF-ASSESSMENT EXERCISE 1

Discuss any four child-centered approach that teachers can use in teaching Basic Science and Technology.

Such methods include:
Discovery Method/Inquiry Method
Discovery method is a structured and unstructured exploration in laboratory or else where in which the student through his/her mental processes such as observation, measuring, classifying, hypothesing can draw conclusion from data that has been generated and analysed. Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge and is a method of instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies. It involves the following processes:

- Formulating problem for investigation
- Formulating hypothesis to guide the investigation
- Designing experiment to collect data
- Analysize and synthesize data to form solution
- Acquiring scientific attitudes in carrying out these processes

Discovery method though it is slow and time consuming, difficult to manage for large class as well as cost intensive, it equips the learner to be owner of his/her knowledge. It is student-centered and inculcates manipulative skills in the learner. It enhances retention, recall and transfer of knowledge. It encourages analytical thought in the learner.

Discussion Method:
This is a learner-centered and is anchored on the principles of self construction of knowledge where the learner is the owner of his/her knowledge. The teacher role is a facilitator. The teacher moderates learning process, acts as a catalyst to set the learner thinking and reflecting. The teacher helps the leaner to build on the prior knowledge, motivates then to reason more. Like many of its type, discussion method does not allow for easy coverage of syllabus. All topics cannot be handled through discussion method. Attention of students may wane if it lasts long and it is time consuming. In the other hand, it is useful in motivating students' activities in developing positive interpersonal relationship between the students. It involves students' active participation and builds confidence I the leaner.

SELF-ASSESSMENT EXXERCISE 2

What are the merits and demerits of project method?
Project method requires originality from the student. In project methods, the students generate his/her own problem or the teacher provides it. Most projects to be done by the students are contained in the curriculum and in the textbooks. It is a student-centered approach pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to complex question, challenge and problem. It integrates knowing and doing (Markhams, 2011). Project method is child-centered and progressive education. It allows the students to solve problems with a little teacher direction. The teacher is seen more of a facilitator. In project method, students are allowed to explore and experience their environment through their individual interest. Emphasis is on experimental learning. It focuses on democracy and collaborative to solve purposeful problems, Knoll (2014).

SELF-ASSESSMENT EXECISE 3

Discuss the merits and demerits of laboratory method.
Laboratory method is an activity packed method for group or individual learner(s) target at making personal observations of processes, products or events. Laboratory method can either be laboratory exercise or laboratory experiment. All laboratory exercises are experiments but not all experiments are laboratory work. Laboratory method is adequate for illustrating scientific

principles, laws as well as inculcating in students how to write laboratory reports. It provides students opportunity to develop manipulative and practical skills. It inculcates in student habit of critical thinking and enables them imbibe the culture of replication. It develops in the students the scientific processes of observing, classifying, measuring, interpreting and inferring. However, laboratory method is expensive, delicate and dangerous and is prone to accidents.

SELF-ASSESSMENT EXERCISE 4

Discuss the relevance of field trip in the teaching of Basic Science and Technology

Field trip adopts excursion to places for educational purpose. It is generally outside the classroom for the purpose of making observation and obtaining specific information from original or natural condition. It brings the learner close to real life situation and creates positive attitude towards science. It involves many of the senses and help to create keen interest in the learner. It encourages team spirit which can be used in the discussion group. Its disadvantages are that it is difficult to plan and execute. It attracts extra financial burden and is accident prone.

3.2: Selecting of Teaching Method

SELF-ASSESSMENT EXERCISE 5

What are the criteria for selecting teaching method?

Before selecting teaching method, the teacher should consider the following:

(i). Age of the learner: Both the physical and mental development of the learner must be considered in selecting method for teaching

(ii). Topic to be taught: All topics cannot be taught with the same method as earlier mentioned. The nature of the topic determines the type of method to be used in teaching it. To be considered is the extent the method is suitable for the topic and the group without placing stress on the learner.

(iii). Competence of the teacher: The teacher must select method she/he can easily and effectively handle.

(iv). Size of the class: The size of the class is very essential in the choice of method to use. Large classes are taught using discussion method while laboratory method can suitable for small class.

(iv). Resources available: Availability of resources helps on selecting teaching method. Some method involve complex materials and can the materials be locally produced or imported

(v). Time for the teaching: The time in the time-table when the topic is taught influences selection of teaching method.

SELF-ASSESSMENT EXERCISE 5

Discuss the use of Information Communication Technology (ICT) in the teaching of Basic Science and Technology

As stated in National Policy of Education (2009) government proposed that integration of ICT into education in Nigeria begins from primary school. Much emphasis was placed on the use of ICT in the teaching of Basic Science and Technology. It is the wish of the Federal government of Nigeria that ICT skills be inculcated in pupils from Basic Education. ICT is not only a learning tool but also a teaching tool and teaching method. According to Webb (2005) ICT rich environment identified from recent research reviewed literature can support students' learning in science in schools with a proposed framework for pedagogical practice in science education.ICT support learning through four main effect: promoting cognitive acceleration, enabling a wider range of experience, increasing students' self-management and facilitate data collection and presentation ICT provides environment for integration of school subjects and is used to teach all school subjects. Anu, Kapil, Sameer and Seema (2011) opined that the role of ICT in teaching process helps in solving many educational programmes. It can be used for tutorials, as simulations, drilling. It is very useful in handling large classes. According to Baishakhi and Karmal (2016) the role of ICT in the 21st century's teacher education is inevitable for usability of it in the teaching and learning process.

4.0: CONCLUSION

No single teaching method is exceptional the best for teaching Basic Science and Technology. However, child-centered approach as discussed is the best approach for teaching Basic Science and Technology. Suitability of method depends on the age of the learner, the topic and the competence of the teacher. Each method has its merit and demerit. An effective teaching combines two or more method in the process of teaching and learning to achieve the varied objectives stated.

5.0: SUMMARY

In this unit we discussed the general methods for teaching Basic Science and Technology, their advantages and disadvantages were discussed The use of ICT as a teaching and as a method of teaching was highlighted.

6.0: TUTOR-MARKED ASSIGNMENT

Take a topic from Basic Science and Technology, list your instructional objectives and select teaching strategies that can effectively help you to achieve the stated objectives, justify your selection.

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UNIT 5: RESOURCES FOR TEACHING BASIC SCIENCE AND TECHNOLOGY

CONTENTS

1.0: INTRODUCTION

Integrated Science is an approach to investigating nature in one's environment which involves extending the laboratory and classroom to the use of locally and easily available materials from the environment (Green, 1983). The emphasis on environmental resources is clearly illustrated by one of the objectives of Basic Science and Technology which is to teach pupils how to tackle some of the questions that arise from observation of their own environment as it affects their daily life (Federal Ministry of Science and Technology, 1985). The National Curriculum for Basic Science and Technology Education (2009) reflects the importance of getting children well equipped with resources in their environment which according to Abdullahi (1983) provides a greater human and instructional laboratory. In this unit you will be exposed to the different resource materials for teaching Basic Science and Technology as well as the concept of improvisation.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Discuss and outline the different types of resources for teaching Basic Science and Technology
- Explain the importance of environment asvaluable resource material for teaching Basic Science and Technology
- Explain the concept of improvisation

3.0: MAIN CONTENT

3.1: RESOURCE MATERIALS

Resource materials are those materials human and non-human that facilitate learner's learning process. They are the medium through which the teacher concretizes ideas to the learner. There are three categories of resource materials necessary for delivery of quality Basic Science and Technology education: human resources, materials resources and financial resources.

SELF-ASSESSMENT EXERCISE 1

Discuss human resource type for teaching Basic Science and Technology.

Human resources are persons including the class teacher who has helped students to understand the concept, ideas and knowledge presented to them. Human resources include the teacher, the pupils, experts from scientific establishment, personnel from factories, health centers, scientists, local craftsman who may brought to give the learner first-hand information and experiences in certain scientific skills and knowledge. A content analyst of the Basic Science and Technology curriculum revealed that a range of recommended human resources. These include drawing on the pupils' experience, teacher and pupils' participation in illustrations and demonstrations, inviting experts to give talks and trips.

SELF-ASSESSMENT EXERCISE 2

Outline the material resources that are relevant for teaching Basic Science and Technology.

Material resources are materials found in nature that can be used for practical, human purpose that are considered to have value. Materials resources abound such as wood, glass, rocks, chemicals etc. The material resources are those local materials within the school surroundings such as the school garden, school laboratory, science room or nature corner, ponds, streams, town or village market, stones, working spaces, hospitals, industries, museums, zoo and natural habitats. NERDC (1988) recommended materials resources for integrated science to include resources within school laboratory and compound, visit to building sites, the zoo, the airport and big farms These are things that can help the learner to concretize the concepts exposed to them in the classroom and relate them to their life and solve the problems related to them in the society.

3.2: IMPROVISATION

National Policy on Education for basic education emphasizes much on improvisation for the teaching of Basic Science and Technology. It is an art of the teacher to provide alternative to facilitate teaching when the original materials are not enough or not available. The process of improvisation involves the use of local materials to provide materials that can help students understand the concepts taught in class or elsewhere. It is generally initiated by the teacher but the learner can participate in the process of improvisation by collecting materials for the improvisation. It is a teaching tool because in the process of improvisation the students are learning. It is also an instructional tool. It is a construction process because it is used to develop useful materials that can be relevance in solving problems in the society. It is a student centered because students are involved in improvisation. One characteristics of improvisation is that the use of local materials from the environment of the learner to produce the material needed for teaching. Improvisation though very important in teaching and learning is time consuming and cost. But it develops in students skill of invention, removes the abstract nature of science and bring in cultural milieu in the learner in science (Ezeliora, 1995). According to Adu and Adu (2014) improvisation is an essential tool for improving the teachers' knowledge in basic technology. Holdhus, Hoisaeter and Mallard (2016) explained improvisation as basic tool for learning science.

4.0: CONCLUSION

It is at the heart of Basic Science and Technology curriculum that it be taught using varied types of resource materials if its goals of developing investigative skills for technological growth and economic empowerment come 20-2020 will be achieved. Human resources apart from the class teachers, experts in every sphere of science are eligible resource for teaching and learning science. Both materials and human resources draw the learner to close observation of their environment. Improvisation in integrated science has a double role as instructional technique and a learning tool for beginners in science. It helps the learner develop manipulative skill using materials from the environment to solve day to day problem.

5.0: SUMMARY

In this unit we have discussed the major resources used in the teaching and learning processes of Basic Science ad Technology programme. The role of improvisation was made very clear and human resources are vital to the implementation of integrated science programmes.

6.0: TUTOR-MARKED ASSIGNMENT

From your community invite expert in any desired area of science to talk to your students on scientific issues of the time such as HIV/AIDS, drug abuse.

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MODULE 3: TECHNIQUES FOR TEACHING INTEGRATED SCIENCE

Unit 1: Planning for Integrated Science Teaching
Unit 2: Integrated Science Laboratory, design, Safety and Management
Unit 3: Evaluation Procedures of teaching and Learning Outcome of Integrated Science

INTRODUCTION

The concern of this module is to expose you to the techniques and preparation necessary for teaching integrated science. The teacher shold know about the BST curriculum, its philosophy and objectives. The module will help you to develop scheme of work from the curriculum, develop lesson plan and lesson note. In this module you learn about integrated science laboratory, its organization and safety. The modul will also expose you to computer appreciation as well as different evaluations methods of the learning outcomes. The module is divided into four units:
Unit 1: Planning for integrated science teaching
Unit 2: Integrated Science Laboratory, design safety and management
Unit 3: Evaluation Procedures of Learning outcomes in integrated science

UNIT 1: PLANNING FOR INTEGRATED SCIENCE TEACHING

Contents

1.0: INTRODUCTION

This unit provides information on documents that are available for Integrated Science teachers to teach Basic Science and Technology in the schools effectively namely: Basic Science and Technology syllabus, scheme of work, lesson plan and lesson note.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Develop BST scheme of work from the curriculum document
- Prepare lesson plan of one BST topic
- Prepare a format for BST lesson note

3.0: MAIN CONTENT

3.1: PRE-REQUISITE CONSIDERATION IN PREPARING TO TEACH BST.

The first consideration by the teacher of BST is to look at the BST curriculum, read the philosophy and objectives of the curriculum as well as the activities outlines for each topic. The teacher considering the age of the student, will think of the teaching approach appropriate for the age and the type of materials to be used. The curriculum is an educational programmed planned for a specified level of an academic institution developed by curriculum planners. It is from the curriculum that the class syllabus, scheme of work, lesson plan and lesson notes are developed by the teacher.

SELF ASSESSMENT EXERCISE 1

What is BST syllabus

The curriculum as explained is compendium of activities, the learner is exposed to, in BST from year one till the program is finished in junior secondary school year three. The syllabus is a condensed outline of the main topics of the school system. Syllabus is developed based on level of the learner. It is an outline of the work with each class at school level in BST. It is arranged in a logical, spirally sequence for the period of 9-years of basic science and technology education. It is generally done by experts. The syllabus takes into account:

- The depth of coverage of the BST topic
- Sequence treatment of topics indicating the topics that require more time.
- Guidelines for method of teaching
- Reference and materials needed for each topic.

SELF-ASSESSMENT EXERCISE 2

Outline a scheme of work for a term.

Scheme of work is a weekly arrangement of topics from the syllabus to be covered during the academic year. It is generally done by the class teacher. This is achieved by dividing the syllabus into 3 parts corresponding to 3 terms in an academic year. The topic in each term schedule are broken up to several weeks in a term, by doing so, the teacher has succeeded in drawing the scheme of work for BST showing day to day learning experience, the topics to be studied. The scheme of work is thus a written plan showing what BST topic are to be covered weekly taking into consideration the following factors as stated by Abdullahi (1982):

- The need for logical sequence
- The age, ability and previous knowledge of the students.
- The amount of time required for each topic
- Number of effective teaching weeks in a term
- Number of teachings per a week
- Resource materials for teaching each topic.

SELF -ASSESMENT EXERCISE 3

Write a format for Basic Science and Technology lesson plan on a topic.

Lesson plan is a daily guide to the Basic Science and Technology teacher. It is a guide to the teacher in presenting a good and effective BST lesson in class. Lesson plan is said to be a guide to effective BTS teaching as it directs the science teacher in the same manner a compass gives a navigator his or her bearing. It is a daily outline of learning activity for BST students usually drawn up after the preceding BST lesson. Lesson plans are not prepared for a long time due to new innovative approaches which the integrated science can use.

Format for a suggested daily Basic Science and Technology Lesson Plan

Subject- Basic Science and Technology

Class- JS1

Date- 17/9/91

Unit- Living Things in the Environment

Topic- Plants and Animals

Average age- 9 years

Time of learning- 9.05-9:45am

Instructional objectives:

These are objectives stated in terms of what the student should acquire/gain during the lesson. It focuses attention on the learner's understanding of the concepts taught and usually stated using active verbs such as differentiate, decide, draw, classify, demonstrate.

Resources:

This explains the type of materials the teacher thinks are suitable for the topic and age of the learner.

Introduction:

This is the set induction or manner the teacher finds suitable in introducing the topic.

Learning Activities: This shows step by step presentation of the topic to students

Time: Time each step of activity lasts

Evaluation: In a form of assessment the teacher uses varied methods to determine the extent the students learned what was taught

Summary: These are salient points the teacher put down on the chalkboard for students to copy as a reminder of the important points to record.

SELF-ASSESSMENT EXERRCISE 4

Differentiate between lesson plan and lesson note.

Lesson note is a detailed description of all learning activities by both the teacher and students selected for a particular lesson showing how the lesson will be produced, previous knowledge of the learner, descriptions of the different methods to be used as well as questions to be asked will be included. The form of lesson notes depends on the subject, category of learner and available resources. Thus, the difference between lesson plan and lesson note is a matter of details. Integrated Science lesson plan is easier to write and short to be read quickly but lesson note indicates clearly the content and method of the lesson and aids the teacher's memory. Lesson plan is an outline of the teacher's business and lesson note gives full account of step by step of the instruction.

A Specimen of Basic Science and Technology Lesson Note on Plant and Animal

School: Name of the School

Date: day/month/year

Subject: Basic Science and Technology

Class: JSSI

Time: 40mins

Unit: Living things in the environment

Topic: Plant and Animal

Objectives: At the end of the lesson, the students will be able to:

- Differentiate between plants and animals
- Classify animals according to their food-herbivores, carnivores and omnivores
- Classify animals according to backbones vertebrates and invertebrates
- Classify plants into flowering and non-flowering plants

Previous Knowledge: Students have learnt the characteristics of living things

Teaching Resources: Each student will to come to school with a plant. The teacher brings to class bottles containing some living animals.

Introduction: The teacher introduces the lesson by asking the students the following questions:

(i) Name one characteristics of living things

(ii) Give examples of living things in the school compound

The teacher links the answers given by students to today's lesson and then writes the topic on the chalk board.

Presentation:

Step 1:

The teacher asks the students to name different animals and the food they eat.

Step 2:

The teacher asks the students to group the animals mentioned into the type of food they eat. The teacher uses the students' grouping of the animals to give each group its biological terminology carnivores, herbivores and omnivores

Step3:

From the students' list of animals, the teacher asks the students to group the animals into backbone and those without backbone. The teacher explains what is meant by backbone. The teacher builds on the students grouping to explain and give each group their terminology-vertebrates and invertebrates

Step 4:

The teacher told the students look at their plants and decide if they can bear flower. The teacher uses their reply to group the plants into flowering and non-flowering plant

SUMMARY

These are what the teacher should leave on the chalkboard for students to copy in their note:

- Both plants and animals show all characteristics of living things(they grow, feed, breathe, excrete, reproduce and respond to stimulus)
- Animals are grouped into carnivores (those that feed on flesh example- dog, lion) herbivores (those that feed on grass example- goat, cow) and omnivores (those that feed on both grass and flesh example- human being)
- Animals with backbones are called vertebrate animal example- fish, goat, man
- Animals without backbones are called invertebrates example- snake, spider
- Plants that can bear/produce flower are called flowering plants example- maize, paw-paw, orange
- Plants that cannot produce flower are called non-flowering plants example- palm tree.

Evaluation: The teacher asks the students the following questions orally

(i) Distinguish between plant and animal
(ii) Name two invertebrates and vertebrates animals in your compound

Assignment: The teacher gives the students the following assignment as home work
List 10 herbivores, omnivores and herbivores animals in your village.

4.0: CONCLUSION

In this unit, you learnt that teaching of integrated science is a serious business that involves dedication and commitment by presenting quality teaching to the students.

5.0: SUMMARY

In this unit, you learnt:

- The meaning of the concept syllabus and from where it is developed
- The description of Scheme of work and how it is developed

- The differences between lesson plan and lesson note

6.0: TUTOR-MARKED ASSIGNMENT

Develop a lesson note you will use to teach States of Matter in Basic Science and Technology.

7.0: REFERENCES/FURTHER READINGS

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UNIT 2: INTEGRATED SCIENCE LABORATORY, DESIGN, SAFETY AND MANAGEMENT

CONTENT

1.0: INTRODUCTION

Laboratory is an integral part of science education. Integrated Science has its laboratory as stipulated by NUC Benchmark. Just as there is biology, chemistry and physics laboratory, there is Integrated Science laboratory designed for the teaching and learning of Integrated activities of Basic Science and Technology education. In an Integrated Science class there is a small space designated as Nature corner where materials for teaching in the classroom are kept. Integrated Science laboratory is one of the criteria for NUC accreditation of Integrated Science programme in the department of Science Education**.**

2.0: OBJECTIVES

After studying this unit, you would be able to:

- Differentiate Integrated Science laboratory from other science laboratories
- Describe a nature corner
- Explain the design and management of Integrated Science laboratory
- Discuss the safety standard for Integrated Science laboratory.

3.0: MAIN CONTENT

3.1: Description of Integrated Science Laboratory

Integrated Science laboratory is an instructional facility used by the Integrated Science teacher to help students learn about science and how scientists investigate and acquire knowledge about the world around them and use the knowledge to invent, create and innovate to better the conditions of the society in which they live. It is a school building set aside for scientific activities. Integrated Science laboratory is very important for the teaching of Basic Science and Technology because the curriculum emphasized students' full involvement in science practical works. The emphasis on laboratory work is to enable the students in the early stage of learning science develop scientific skills and attitudes. Nagaraj (2013) perceived integrated science laboratory as tool for holistic and constructive learning.

SELF-ASSESSMENT EXERCISE 1

What is Nature Corner?

Nature corner is a space created at a corner in the classroom where materials used for teaching Basic science and technology are kept for at least a week

before they are taking back to the laboratory. Also materials brought by students for teaching are allowed to remain at the Nature Corner a week before removal to the integrated science laboratory if they are relevant. The benefits of Nature Corner abound:

- It reminds the students of the science topic taught that week
- It draws the attention of the students to the relationship between science in the classroom and their environment.
- It makes the materials easily accessible for teaching in the classroom
- It helps the students remember what they were taught for the week in Basic science and Technology
- It is child-centered because the students are involved in the building of the Nature Corner.

SELF-ASSESMENT EXERCISE 2

What will you consider special in the designing of Integrated Science laboratory?

As earlier said Integrated Science has its own laboratory as stipulated in the NUC Bench mark for accreditation of Integrated Science degree programmes. It consists of a lager hall well ventilated and lighted equipped with laboratory benches fixed with burnsen burner, wash hand basin. In the large hall equipment is arranged according to what they are used to teach. For instance, physics-based materials are kept together to ease selection and use so also other integrated science programmes. Everything needed in science laboratory is in the Integrated science laboratory but are displayed in the lager hall in partitions. Integrated science laboratory has storage room where materials not in use are kept. It has technologist room where the technologist managing the laboratory stays. There is also a display room where students' projects or products are kept. In integrated science laboratory Mathematics has its own partition in the laboratory with rulers of different kinds, measuring equipment and other related materials are kept.

SELF-ASSESSMENT EXERCISE 3

Who takes care of the management and safety in the Integrated Science laboratory?

With the description and contents of integrated science laboratory as discussed above, there is need to ensure proper management and safety of both the materials and those using the laboratory. Integrated science laboratory must

have a technologist to keep the laboratory clean, organize and arrange the activities in the laboratory. The technologist records and keeps the inventory of all that are in the laboratory including unused ones. The technologist gets materials ready for the integrated science teacher. Like every other laboratory, integrated science laboratory is prone to accident. To ensure the safety of the materials and those using them the technologist will ensure that laboratory rules and regulations are observed when practical is going on and that equipment arranged and stored properly. The following safety rules should be enforced in an integrated science laboratory:

- Do wait outside the laboratory until you are asked to come in
- Do only the experiment authorized by your teacher
- Do heat liquids slowly and rotate the tubes to avoid over heat
- Do wet the end of the glass tube before inserting it into rubber-tube
- Do report any gas leakage
- Do not run or play or rush in the laboratory
- Do not eat in the laboratory

SELF-ASESSMENT EXERCISE 4

What type of accidents happen in the integrated science laboratory?

It is a common thing that even when all necessary precautions and measures are taking and safety regulations are enforced, integrated science laboratory like other laboratories is prone to accidents or accidents occur. The common injuries in integrated science laboratory are:

- Bleeding due to cut glasses, broken glassware, sharp objects
- Burn from naked fire and chemicals
- Shock from electricity
- Suffocation from inhaling injurious vapour
- Eye injury from particles

It is the duty of the integrated science teacher/ technologist to educate the students on safety rule and regulations. It is also their responsibility to offer appropriate first aid remediation in case of any accidents in the laboratory.

4.0: CONCLUSION

In this unit, you learnt about integrated science laboratory, its design and safety. The organization and management of integrated science laboratory and the role of the teacher and technologists were also discussed.

5.0: SUMMARY

In this unit you learnt that:

- Integrated science has its own laboratory different from other science laboratories to suit the nature of activities that take place in it.
- It has all the facilities of a laboratory such as storage room, preparatory room, well ventilated with lighted, has source of water and heating instrument
- Safety in integrated science laboratory is paramount
- There must be a technologist to manage and organizes the activities in the laboratory
- It is a NUC requirement for accreditation of Integrated Science degree program.

6.0: TUTOR-MARKED ASSIGNMENT

Discuss the relevance of integrated science laboratory in achieving the objectives of Basic Science and Technology curriculum

7.0: REFERENCES/FURTHER READINGS

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Unit 3: Evaluation Procedures of Teaching and Learning Outcome of Integrated Science

1.0: INTRODUCTION

One of the main duties as an integrated science teacher is to promote the learning of the fundamental tasks and principles of Basic Science and Technology curriculum and develop in the students the abilities and skills needed to engage in scientific processes. However, as the acquisition of scientific knowledge is the ultimate criteria, it is imperative to regularly evaluate students' progress in their learning of Basic Science and Technology. Your role as a teacher in evaluation of students is very important and crucial. Thus, you should be well equipped for the performance of the task. In this unit you will be exposed to one of the commonly used methods of evaluation which is teacher's test.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Discuss the principles of test construction
- Construct marking scheme
- Importance of Project-based assessment

3.0: MAIN CONTENTS

3.1: TEST AND ASSESSMENT

Teaching and learning processes are incomplete without determining students' learning outcome (Obi, 1977 and Folagbde, 1988). From the expert's view, test is the most reliable method available to practicing teachers of education of early learners for assessing their learning outcome. Obe (1977) defined test as a series of activities purposely designed to measure learner's abilities to recall fact. According to Findley (1963) functions of test are categorized into instructional, guidance and administrative.

Instructional function—Testing of students' progress in the science class provides the teacher with the information on the students' rate of learning.

Guidance function—Reports of test are counseling tools for the teacher, guidance counselors, parents, administrators in matters of career choice

Administrative function—It is a quality assurance for schools. It assists in grouping or placement of students. There are four different forms of test.

SELF-ASSESSMENT EXERCISE 1

Explain the different forms of test

Test is an assessment model for determine students' learning outcome in a subject at mid-term or at the end of a session or after a topic. A test most be valid, reliable. There are four forms of test namely:

(i) Essay type of test- This is used to evaluate the qualitative aspects of verbal instruction which requires the student to compose a response.

(ii) Objective test—An objective test is one in which there is only one answer to each question

(iii) Multiple choice test—In multiple test each test item has a number of alternative answers from which one is correct.

(iv) Short answer item of completion test

Any of these forms of test can be used by the teacher but the choice of which form to use lies on the teacher.

SELF-ASSESSMENT EXERCISE 2

Outline the principles of test construction in integrated science course.

In constructing a test, the following points are considered:

- Identification of major concepts to be tested
- Identification of cognitive levels to be tested
- Decision on the number of test items to be included in the test
- Preparation of table of specification to guide the teacher on the number of test items from each concept

Table 1: Table of specification for an integrated science multiple choice test

Specification for Theme	Knowledge	Comprehensive	Application	Analysis	Synthesis	Evaluation	Total
Family Traits	2	1	1	0	0	0	4
Environmental hazard	6	5	2	0	0	0	13
Drug Abuse	2	1	1	0	0	0	4

Resources from Living Things	3	1	1	0	0	0	5
Resources from non-living Things	2	1	1	0	0	0	4
Total	15	9	6	0	0	0	30

Table 1: Illustrates the specification required in terms of Basic Science for Theme 1 and the cognitive levels. The table shows that 5 Basic Science concepts are to be tested across the 6 cognitive levels as stated by Bloom (1956). The number of items to be selected from each concept is indicated and the number of items per a concept is spread across the cognitive levels.

SELF-ASSESSMENT EXERCISE 3

What is a marking scheme?

A marking scheme is a model solution prepared by the examiner with marks distributed across the different questions in the test. In objective test, the marking scheme requires correct responses and all correct responses carry equal marks despite the varying degree of difficulty associated with the different test items. Marking scheme contains the answer to the question prepared by the who set the question. Apart from objective test that have equal mark, marks are assigned to questions depending on the level of cognition tested. Low level cognition like knowledge carries low mark while high level cognition like application carries and so on carry high mark.

SELF-ASSESSMENT EXERCISE 4

Discuss project-based assessment.

The use of project-based assessment techniques has continued to grow within education curriculum as resources and concepts beyond traditional testing applications are involved. There can be extensive value to the student's overall learning process with the addition of project-based learning to supplement standard curriculum materials. Assessment that compile into project-based assessment are also a technique option for educators looking to review the

ability of students to be creative, diverse and authentic with their course work and experience gained throughout the time frame of the class. Project-based assessment are opportunity to utilize and measure the higher order thinking skills of students. This can be a singular project at the end of a grading period or it can be done at designed intervals throughout the marking period. The important thing is to design the project-based to encompass the lesson plans, teacher worksheets and any additional teacher resources which will provide a physical example of what has been learned and what can be applied by the students. The criteria for project-based assessment can be as specific or as generic as a teacher designates. Developing rubrics to define the class structure and curriculum design can be an effective means of applying project-based learning skills. Worksheet can help guide both the teacher and students in assessing project. In project assessment the teacher look out for the application of science skills, the extent the student used them accurately to reach the end product. The key word in Project assessment is accuracy.

4.0: CONCLUSIONS

In this unit you noticed that evaluation of teaching /learning processes is a continuous process and an integral part of curriculum development and classroom instruction. As a teacher, you need to understand the necessity of assessment of students learning outcomes and its importance in planning the life of the learners.

5.0: SUMMARY

In this unit, you have learnt that:

- Test is the most reliable method for assessing early learners' outcome
- Test is designed to measure the student' level of cognition.
- Marking scheme guides the teacher in scoring of students' test.
- Bloom Specification should be used to ensure the evaluation of all cognitive level.
- Students' projects are evaluated.
- Test construction has a guiding principle

6.0: TUTOR-MARKED ASSIGNMENT

Differentiate between low and high cognitive live in Bloom Specification

7.0: REFERENCES/FURTHR READINGS

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