COURSE GUIDE

EDU 754
SUBJECT METHODS (INTEGRATED SCIENCE)

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REVIEWED EDU 754 INTEGRATED SCIENCE FOR NOUN

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 and spirit of science; science education curriculum reforms in both primary and secondary school levels and psychological theories of learning and their implications and applications for science teaching. You will learn also the about improvisation and the relevance of ICT in teaching and learning process as well as the importance of integrated science laboratory, its safety and management. The course will introduce you to STEM a true application of integration in sciences.

COURSE AIMS

The aim of this course is to prepare you towards teaching integrated science in the 9years basic science programme in both primary and junior secondary school levels. This will be achieved by aiming to:

* Help you appreciate the nature of science

* outline the trends in science education curriculum reforms in Nigeria

* historical development of integrated science, its philosophy and objectives

* examine the contributions and applications of some cognitive psychologists like Jerome Brunner, Robert Gagne and Jean Piaget in teaching science.

* Deal with the basic methods and techniques of teaching integrated science.

* Resources for teaching integrated science and improvisation.

* Understand the relevance of integrated science laboratory, safety and management in teaching science.

* 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 and applications in teaching integrated science
- outline the methods of teaching integrated science
- describe the various resources for teaching integrated science and improvisation
- describe the usefulness of ICT in the teaching and learning of integrated science
- prepare a syllabus, scheme of work, lesson plan and lesson note for teaching integrated science in both primary and junior secondary classes
- design, organize and manage 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 of 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 eleven study units listed under three modules in this course.

They are as follows:

Module 1: **Historical Development of Integrated Science**

Unit 1: Nature and spirit of Science

Unit 2: Science Education Curriculum Reform in Nigeria

Unit 3: Historical Development of Integrated Science Curriculum in Nigeria

Unit 4: Concept of Integrated Science

Module 2: Philosophical and Psychological Development of Integrated Science

Unit 1: Philosophy and Objectives of Integrated Science
Psychological Theories and Implications for Teaching

Unit 2: Integrated Science

Unit 3: Methods of Teaching Integrated Science

Unit 4: 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 twelve 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 and as 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 – 33	3 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? (remove)
- How have the psychological theories of learning contributed to the teaching of integrated science in our schools?
- Which of the teaching methods will you apply to teach integrated science in our schools?
- What materials can you use for teaching integrated science topics and how will you select them?
- What are the relevant of ICT in teaching integrated science?
- Who manages the resources in the integrated 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 class?

MAIN COURSE

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MODULE 1: HISTORICAL DEVELOPMENT OF INTEGRATED SCIENCE

INTRODUCTION

In this module, you will be exposed to the historical development of integrated science in primary and junior secondary schools. The module will examine the nature and spirit of science, the concept of integrated science and its relationship with STEM (science, technology, engineering and mathematics). The module is divided into four (4) units namely:

Unit 1: Nature and Spirit of Science

Unit 2: Science Education Curriculum Reform in Nigeria

Unit 3: Historical Development of Integrated Science Education in Nigeria

Unit 4: Concept of Integrated Science and STEM

UNIT 1: Nature and Spirit of Science

CONTENTS

1.0: INTRODUCTION

In this unit you will learn the nature and spirit of science, science process skills, product of science, scientific attitude and methods of teaching science as well as different branches of science.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Explain the meaning and relevance of Science to humanity
- Describe science process skills

- Explain product of science
- Describe the scientific attitudes
- Explain methods of teaching science
- List the different branches of science

3.0: MAIN CONTENT

3.1: Meaning and Relevance of Science to Humanity

Science is man's activity to explore and explain natural phenomena. It is a process of acquiring knowledge of our environment. Science is a body of organized knowledge acquired through a process of enquiry on our environment (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. Through science man come to have knowledge of his/her environment and how to use the natural materials for his/her survival. Science has helped man to discover and explore his/her environment. Through science man is able to discover the minerals, crude oils in the ground, discover the benefits of trees to man. From all these man is able to develop, build and manufacture many things that have made human life better. Science has made man to fulfil the injunction by God to till and subdue the earth, (Ezeliora, 2016).

3.2: Science Process Skills

These are methods or processes peculiar to science in determining the facts about nature. They are called scientific method or science process skills. They include: observation, classification, measuring, prediction, analyzing, inferring, synthesizing, describing, experimentation. These are the step by step actions used in the process of acquiring scientific knowledge. In the process of applying the science method, the individual develops some science skills. The science process skills are:

Observation: critically observing, touching, smelling where possible of an object so as to describe the object.

Classification: grouping the objects according to their nature such as solid, liquid, gas, living or non-living

Measurement: determine the size, volume and weight of the object

Prediction: From the above information the individual can guess what the object is.

Analysis: Go into details to determine the characteristics and properties of the object Such as boiling point, melting point, soluble or insoluble in water, action on heat and so on.

Inference: From the results of the above you can give a name to the object

Synthesis: Use the object with other object to find what will be formed and its difference from the original object.

Description: Explain the characteristics of the new objects with original.

Experimentation: Subject the object to various other products.

From these processes knowledge is built and developed.

3.3: Scientific Attitudes:

In the process of acquiring the science process skills the individual develops certain attributes, behaviours or attitudes known as scientific attitudes. Such attitudes which are characteristics of scientists are:

Curiosity: This is eagerness to know, to find out and ask questions of why, what and how.

Objectivity: Giving judgement based on what one sees without sentiment.

Humility: Ready to accept corrections and criticism from others

Scepticism: Not just accepting stories on the first value. Make further enquiry.

Open mindedness: Ability to work and be open to others.

These are beliefs, values, qualities and opinions held in awe by scientists.

3.4: Product of Science:

In investigating phenomenon or event, scientific processes are uses to gather data. These data will be analysed and interpreted to give us the product of science which is the knowledge acquired. 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.

3.5: Methods of teaching science:

Science is a process. It is activity oriented. Its knowledge is acquired by doing. It is learnt by action. Teaching of science in school involves activity oriented methods. It is

best taught using inquiry method where the learner will apply the process skills to acquire knowledge. Inquiry methods are:

Project-based science teaching: Project help students to learn ways science can be used in their life. It is child-centred. The teacher's role is to assist by refocusing or clarifying ideas underlying the assigned topics. According to Ezeliora et al (2011) it develops inventive skills in the learner as well as process skills.

Research: We may be scared to embark on research in primary or junior secondary school due to lack of sufficient scientific background. Give it a trial. Give a topic to the children to inquire from parents, books, seniors what it means and its relevance and record the account of their findings for presentation in the class.

Field Trip: This is used to engage children in real world of science. It is more than taking the children to a site but includes preparation, follow-through upon returning to school.

Concept mapping: This is a schematic representation of concepts and their inter-relationship in a framework that makes learning meaningful. Concept mapping normally begins with one main idea which branches into related general concepts which are subdivided into specific concepts. Lines are used to connect the concepts and link words to give ideas about the relationship.

Cooperative Learning Approach: This is an instructional strategy where students are grouped in small numbers of 4 or 5 to accomplish a task. In the group each member is assigned a role so that each child will have equal opportunity to participate and involved in the group activity.

Laboratory Activity: This is an integral part of science teaching. It engages the children in the process of sciencing through active participation. it gives children opportunity to participate in and have an appreciation for the methods of science and develop science attitudes and skills.

There are many other methods for teaching science such as demonstration, discussion, computer assisted instruction.

3.5: Branches of Science

Traditional science is divided into two namely physical science and biological science. Physical science describes the world as observed by use of physical

measurements of mass, length and time or their derived units like velocity, force or volume. Some subjects that make up physical sciences are: geochemistry, geology, geophysics, hydrology, mechanics, metallurgy, meteorology, nuclear science and oceanography, aerodynamics, architecture, astronomy, chemistry, computer science, dynamics, electrochemistry, electronics, optics, physics, space science, solid-state physics, seismology and thermodynamics. Biological science deals only with the materials that are alive. The various subjects that make up the division of biological sciences are agronomy, anatomy, bacteriology, biochemistry, biology, biotechnology, botany, marine biology, cytology, dentistry, ecology, embryology, forestry, genetics, genetic engineer, histology, zoology, morphology, physics, nutrition, palaeontology, pharmacology, pharmacy, physiology, veterinary and medicine. Among the common school sciences are Physics, Chemistry and Biology.

SELF-ASSESSMENT 1

3.6: What is the relevance of science to humanity?

Science has helped man to know, understand and explore his/her environment. It has helped man to develop the environment for better living. Through science man has invented a lot of things such as drugs, food, textiles, built roads, aeroplanes, go to the moon, invented machines, electricity and many other things for the benefit of man.

SELF-ASSESSMENT EXERCISE 2

3.7: Explain the term science process skills

Science process skills are skills acquired in the process of doing science. It is acquired when one applies scientific methods in gathering knowledge. In the process of gathering knowledge the individual will develop the skills of observation, measuring, classification, inferring, experimenting and prediction and so on. These skills are called science process skills.

SELF-ASSESSMENT EXERCISE 3

3.8: Explain the term scientific attitudes.

In the process of doing science, students use scientific methods. The method generates knowledge which is the products of science. In the process of developing science products the student at the same time develops some attitudes or characteristics as a result of the method used. It reflects in his/her way of thinking as seen in scientists.

These attitudes are called scientific attitudes. The scientific attitudes are honesty, humility, critical and judgemental mind. 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 and spirit of science.

5.0: SUMMARY:

In this unit we have discussed the nature and spirit of science. The science process skills which is acquired through scientific method together with the knowledge, the scientific attitudes developed helps to understand the nature and spirit of science. Science is very relevant to humanity. 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

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UNIT 2: SCIENCE EDUCATION CURRICULUM DEVELOPMENT AND REFORM IN NIGERIA

1.0: INTRODUCTION

This unit introduces you to the curriculum development and reforms in science education in Nigeria.

2.0: OBJECTIVES

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

- Advance reasons for reform in the science curriculum in Nigeria
- Narrate the trends in science curriculum reform in Nigeria till date

3.0: MAIN CONTENT

3.1: Science Curriculum Development and Reform in Nigeria

In Nigeria the introduction of some form of science dates back to the time of the Christian missionaries in 1840s and 1850s. Serious teaching of science was delayed by the missionaries and the colonial rulers. Since the motive for colonization was

essentially exploitative trade and only tangentially education, the issue of science education for the natives could not have risen. Africans like Nigerians were assumed to be inferior human beings incapable of understanding core science. What was taught as science was called Nature Study initially. Later it was up graded to General Science. When science was introduced in the primary schools, physics, biology and chemistry were taught in secondary schools.

The science curricula developed were patterned and adapted to foreign ones both in language and presentation, even examples were foreign to our children. With the launching of Sputnik 1 by Russians in 1957, there was a worldwide review of the philosophy of science education. Federal government realising the importance and crucial role of science in nation building, noticing the deficit in the nature of science been taught to Nigerian children cannot lead the country to anywhere. After independent, in 1969 curriculum summit was convened to rview the curriculum in general and adapt it to suit our children and address Nigeria's problem. Science was among the subjects given through reform and review. Science Teachers Association of Nigeria (STAN) formed in 1957 was called upon to develop the science curriculum to suit our learners to the benefit of our country. STAN created and developed science curriculum for primary and secondary schools and later developed Integrated science for junior secondary school. The curriculum of physics, biology and chemistry followed the trend as in developed countries like America and Europe. Variations in curriculum trend were mostly in the primary and junior secondary schools.

3.2: Trends in Primary and Junior Secondary School Curriculum Development and Reform

In Nigeria, a lot of external influences and foreign curricula motivated many of the curriculum innovations in science in primary and junior secondary school. 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 primary levels that will reflect Nigeria's needs and suitable for Nigerian learners. As a

result each region in the federation embarked on curriculum project and developed curriculum for the children of their region. For instance:

- Primary Science Curriculum Project was developed in 1963 at University of Nigeria Nsukka for primary schools in the then Eastern region.
- The African Primary Science Project was developed in 1965 at Kano for the Northern region.
- Bendel State Primary Science Project was developed in 1970 for the Mid-Western region.
- Ife Six Years Yoruba Language Science Project was developed in 1970 at University of Ife the present Obafemi Awolowo University. Ile-Ife for Western region.
- Primary Education Improvement Project was developed at Ahmadu Bello University, Zaria for the Northern region in 1970.
- Ondo State Primary Science Project developed in 1974.

All these science curriculum projects have one common objective to produce child-centred science curriculum for the Nigerian child for technological development of Nigerians.

STAN as a body with the introduction of the 6-3-3-4 education system took charge of developing and reforming of science curriculum for both primary and secondary school students and produced one common science curriculum for primary and junior secondary schools called integrated science which is continuously under constant review to address the needs of Nigerian child. Other curriculum agents are National Educational Research and Development (NERDC). The most resent curriculum under use for integrated science is Basic Science and Technology Curriculum developed by NERDC..

3.3: Basic Science and Technology Education Programme

The most recent innovative curriculum for integrated science is for use in Nigeria is the Basic Science and Technology curriculum. This is developed in line with The Universal Basic Education (UBE) system introduced 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 needs and to make the curriculum more practical, the present curriculum was developed to meet the need to attain Millennium Development Goals and the need to implement the (MDGs) National Economic and Empowerment Development Strategies (NEEDS).

The Basic Science and Technology is also re-structured and re-aligned to include contents like environmental education, drug abuse education, population and family life education and sexually transmitted infections. The overall objectives of new science curriculum are to enable the learners:

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

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 Basic Science and Technology (BST) are 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).

SELF-ASSESSMENT EXERCISE 4

3.1: Give a brief description of the trend in science curriculum development and in reform Nigeria.

Development of science curriculum in Nigeria dated back to the Christian missionary era. With Nigerian independent in 1960 coupled with worldwide influence of Russia's going to the Space in 1957, Nigeria government joined the rest of the world to adapt science curriculum to the needs of the nation. This resulted to each region in the federation to embark on science curriculum project for their region. With the introduction of Universal Basic Education programme and 6-3-3-4 education system, the need for new science curriculum came up. As a result one single science curriculum was developed to serve the need of every Nigerian child in science both in content and arrangement. Further development and reform brought about the unification of primary education and junior secondary school as basic education programme. This resulted to the production of Basic Science and Technology education for both primary and junior secondary school students.

SELF ASSESSMENT EXERCISE 5

3.2: What are the main objectives of Basic Science and Technology Curriculum?

The main purpose of BSTC is to produce a curriculum adaptable to the needs of the Nigerian child so that at the end of it the child will be self-reliant and contribute to the survival of Nigerian society. Its specific objectives include to:

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

4.0: CONCLUSION

Introduction of curriculum in our school system dated back to the missionary era. Subsequent approaches brought series of reforms to the curriculum development

including science curriculum. The unit examined the trends in curriculum development and the subsequent reforms following the subsequent changes in the education system. The main objectives of the present science curriculum for both primary and junior secondary schools are highlighted.

5.0: SUMMARY

In this unit you learnt that introduction of science curriculum in our educational system started with missionary activities in our schools. The earlier curriculum was not meant to develop us. It was not adapted to the needs of the Nigerian child both in language and in content. Every aspect of the curriculum was foreign to the Nigerian child. After independent, Nigerians took to the reform of the curriculum, made it adaptable the Nigerian child so as to addresses the needs of the Nigerian society. The reform of the curriculum is continuous till date following the changes in our education system.

6.0: TUTOR-MARKED ASSIGNMENT

What events led to the development of Basic Science and Technology Curriculum in Nigeria?

7.0: REFERENCES/FURTHER READING

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UNIT 3: HISTORICAL DEVELOPMENT OF INTEGRATED SCIENCE IN NIGERIA

1.0: INTRODUTION

In this unit you will examine the background to the introduction of integrated science in school curriculum, examine the projects embarked for the development of integrated science curriculum and the development of basic science and technology curriculum.

2.0: OBJECTIVES

After studying the unit, you should be able to:

- Discuss the historical background to the introduction of integrated science in school curriculum.
- Discuss the different projects embarked on the development of integrated science curriculum.

3.0: MAIN CONTENTS

3.1: Historical Background to the Introduction of Integrated Science in Schools

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

- 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.

During these periods special interest groups developed attention to basic science in schools. The primary objectives of basic science programmes were first-hand observation and experience. Experimentation and problem-solving types of teaching were considered as significant as scientific techniques. Due to lack of teachers the proposed elementary science could not be practice. This period also witnessed great enthusiasm towards nature from science educators across Europe, America and Africa that geared towards introducing nature study programme in schools. The main purpose of the movement was to improve agriculture and to overcome the desire of farmers' children from leaving the farm for the city. 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.

With physics, chemistry and biology been learnt in the senior or higher classes, attempts were made to launch an integrated aspect of science in the primary schools that will enable the pupils have integrated knowledge of their environment, enable them have a holistic view of their environment. Thus science at that level was given general names such nature study, general science or rural science.

3.2: Development of Integrated Science in Nigeria

In the past four decades, there have been changes in the nature of science taught in our 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 in the primary level. After the 1969 curriculum summit, several primary school science projects were embarked upon by the different regional governments to improve science education in their

region. The following projects such as: 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 by different regions.

However, studying of physics, chemistry and biology in higher classes were expected to cover the whole range of science in a balanced way bringing out the unity among the subjects but the little real unity was observed in the presentation of these courses. The teachers could not achieve any real integration in their teaching of these science courses because teacher training courses rarely prepared the teachers for the unified approach to their teaching of those science subjects in the higher classes. Furthermore, General Science courses were too superficial and inadequate to develop higher level science courses within the little times allocated to them by school authorities. Science at the primary school is considered to help the pupils master the basic understanding of scientific concepts and cultivate the habit of exploring science with an open mind. In view of these problems STAN embarked on curriculum development early 1970's and was mandated to develop science curriculum for both primary and secondary schools. STAN during the planning and development of science curriculum after the 1969 Conference Summit introduced integrated science to enable junior secondary school students acquire the basic skills of science before proceeding to senior secondary science. Primary science was introduced for the primary school. One integrated science text book was produced for each level. 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. With the introduction of 6-3-3-4 education system in which 9-years is for basic education, a science curriculum was develop for both primary and junior secondary school science as represented in the Basic science and technology produced by NERDC.

SELF ASSESSMENT EXERCISE 6

3.1: What Factors Contributed to the Introduction of Integrated Science in

School Curriculum?

Varied factors both social and economic development contributed the introduction of basic science in schools. These include:

- 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.

During these periods special interest group developed attention to basic science in schools. The primary objectives of science programmes were first-hand observation and experience. Experimentation and problem-solving types of teaching were considered as significant as scientific techniques. Due to lack of teachers the proposed elementary science could not be practice. This period also witnessed great enthusiasm towards nature from science educators across Europe, America and Africa that geared towards introducing nature study programme in schools. The main purpose of the movement was to bring about the unified nature of science for agricultural development.

SELF ASSESSMENT 7

3.2: Describe the Trends in the Development of Basic Science and Technology Curriculum.

In 1970s, Science Teachers Association of Nigeria (STAN) was called upon to develop science curriculum for Nigerian schools for primary and secondary levels. After developing the primary and senior secondary school curricula, there witnessed a gap of transmission from primary science to secondary school science. To fill the gap, integrated science curriculum was introduced for the junior secondary level. With the introduction of the 6-3-3-4 education system which brought about the 9-year basic education, one common curriculum was developed in science for the basic levels known as Basic Science and Technology Curriculum for both primary and junior secondary children.

4.0: CONCLUSION

This unit exposed you to the background needs that led to the introduction of integrated science in the school curriculum and the subsequent developments that led to its continuous reforms at different stage especially in Nigeria. The new education system of 9-year basic education gave rise to production the present Basic Science and Technology Curriculum for primary and junior secondary schools science education.

5.0: SUMMARY

In this unit you have learnt the reasons why integrated science was first introduced in the school curriculum and the subsequent educational transformation in Nigeria that led to reforms of curriculum at different stages of our educational system. The latest science curriculum for basic education was produced by NERDC in 2009 and introduced to schools in 2009

6.0 TUTOR-MARKED ASSIGNMENT

Read and explain the objectives of the Basic Science and Technology Curriculum

7.0 REFERENCES/FURTHER READING

Arokoyu, A.A.(2012). Elements of contemporary integrated science curriculum: Impacts on science education. **Global Journal of Education Research.** Vol.(1),49-55

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UNIT 4: CONCEPT OF INTEGRATED SCIENCE AND STEM

1.0: INTRODUCTION

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

2.0: OBJECTIVES

After studying the unit, you should be able to:

- Explain the concept integrated science
- Discuss the characteristics of integrated and non-integrated science
- Explain the concept STEM the spirit of integration.

3.0: MAIN CONTENT

3.1: Concept of Integrated Science

In a simple and general term, 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. 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.

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.

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 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. It encourages innovative teaching and learning approaches and techniques that promote creativity and critical thinking in students, It promotes 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.

3.2: Characteristics of Integrated Science

A critical examination of the basic science and technology curriculum (BSTC) clarifies how integrated science differs from other curricula arrangements. In BSTC science, traditional subjects matter boundaries are completely removed. The BSCT is organized around a selected unifying topic. It 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. 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 BSTC the learning experiences and concepts 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.

3.3: Science, Technology, Engineering and Mathematics (STEM)

Science, technology, engineering and mathematics (STEM) are interrelated and interwoven bundle of knowledge that forms the ingredients for technological breakthrough. It is a typical example of integration of scientific process and science product (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, while the scientist explores what is, the engineer creates what has not existed before and the technologist translates ideas and plans into working realities aware of his/her responsibility and duties towards the society. The same person is a scientist, technologist, engineer and mathematics. The traditional subjects matter boundaries are removed. STEM education brings about the integration of ideals that gives rise to new products. According to Ezeliora (2016) STEM is a typical process of integration of scientific ideas to yield the expected result for human development. The integrated science teacher should always work toward integration of science knowledge while teaching basic science and technology.

SELF-ASSESSMENT EXERCISE 8

3.1: What are the Characteristics of Integration in Science?

In integrate science traditional subjects matter boundaries are completely removed. The learned materials are organised around a selected unifying topics and serves a general education function. The sequence arrangement of topics tries as much as

possible to avoid duplication of content. Integrated science emphasizes organization of learning experiences around a topic or theme. This unification of concepts around a theme makes integrated science unique.

SELF ASSESSMENT EXERCISE 10

3.3:Explain 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 has exposed you to the meaning of integrated science, its characteristics and the resemblance of BSTC as an integrated curriculum. You are also exposed to integration of knowledge in STEM which is the hallmark for integrated technology.

5.0: SUMMARY:

In this unit, you learnt the meaning of integrated science, its characteristics and BSTC as good integrated science curriculum. You also learn the integration of STEM knowledge for technological development so that you apply it in the teaching of basic science. STEM is a typical example of integration of knowledge for the development of innovative, inventive and creative skills in early basic science education for technological development which is the main goal of integration in sciences.

6.0: TUTOR-MARKED ASSIGNMENT

Design a project for your students that will involve use of integration of know acquired from basic science and technology

7.0: REFERENCES/FURTHER READING

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MODULE 2: PHILOSOPHY AND PSYCHOLOGICAL THEORIES OF BASIC SCIENCE AND TECHNOLOGY CURRICULUM

Unit 1: Philosophy and Objectives of Basic Science and Technology

Unit 2: Psychological Theories of Learning and their Implications in Teaching Basic Science and Technology

Unit 3: Methods of Teaching Basic Science and Technology

Unit.4: Resources for Teaching Basic Science and Technology

1.0: INTRODUCTION

The concern of this module is to expose you to the philosophy and objectives of basic science and technology 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 to primary and junior secondary schools. The module will also

introduce you to the process of improvisation of materials for teaching basic science and technology. The module is divided into five units:

Unit 1: **PHILOSOPHY AND OBJECTIVES OF BASIC SCIENCE AND TECHNOLOGY CURRICULUM**

UNIT 2: PSYCHOLOGICAL THEORIES AND THEIR IMPLICATION IN TEACHING BASIC SCIENCE AND TECHNOLOGY

UNIT 3: METHODS OF TEACHING INTEGRATED SCIENCE

UNIT 4: RESOURCES FOR TEACHING INTEGRATED SCIENCE

UNIT 1: PHILOSOPHY AND OBJECTIVES OF BASIC SCIENCE AND TECHNOLOGY CURRICULUM

1.0: INTRODUCTION

You have in the previous units examined the various positions so far taken in integration of science as an attempt to explain the meaning and partly philosophy of integration of science. This unit will therefore be a examination of the philosophy and objectives of basic science and technology curriculum.

2.0: OBJECTIVES

After studying the unit, you should be able to

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

3.0: MAIN CONTENT

3.1: Philosophy of Basic Science and Technology Curriculum (BSTC)

Basic science and technology curriculum is the product of the re-structuring and integration of primary and junior secondary school science curriculum into:

- Basic Science
- Basic Technology
- Physical and Health Education
- Computer and Information and Communication Technology

Developed in line with the requirement of the 9-year basic education curriculum to catch the young learner early to love science, learn science and create changes in the

learners' environment. It is organised to develop a holistic view of science at these levels of education. 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 everyday life and the world in which they live. Integrating principles BSCT produces course which:

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

The sequence of arrangement of topics avoids duplication of content and learning experience organised around a theme. The contents are arranged in modules. This unification of concepts around a theme makes BSTC unique and gives its integration outfit.

SELF ASSESSMENT EXERCISE 9

3.2: Outline the integrated characteristics of BSTC.

The integrated characteristics of BSTC include:

- The contents are developed around a theme
- The contents are organised in module
- It helps the learner to have a holistic view of science and technology

3.3: Objectives of Basic Science and Technology Curriculum

Basic science and technology curriculum was conceived out of the present need and desire of the society to develop holistic view of science and technology at primary and junior secondary school level. BSTC is developed to accommodate the 9-year Basic Education Programme in science and technology. Other factors that influenced the curriculum are the need to attain the Millennium Development Goals (MDGs) and implementation of the National Economic and Empowerment Development Strategies (NEEDS). BSTC is structured around basic science, basic technology, physical and health education and information technology to reduce the number of subjects offered in primary and junior secondary schools 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, promote holistic view of science at all levels 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, globalisation and entrepreneurship into the curriculum. BSTC includes contents like environmental education, drug abuse education, population and family life education and sexually transmitted infections. Each of these are further developed 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 packages**.**

Thus the overall objectives of BSTC are to enable the learner to:

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

The contents are organised around a theme arranged in modules. Specific methods to be used by teachers and students to achieve the objectives were specified such as project method, inquire method, field trip and other innovative methods.

SELF ASSESSMENT EXERCISE 10

3.4: What Are the Specific Objectives of BSTC?

The objectives of BSTC are to enable the learner:

- To develop interest in science and technology
- Acquire basic knowledge and skills in science and technology
- Apply their scientific and technological knowledge and skills to meet societal needs
- Take advantage of the numerous career opportunities offered by science and technology
- Become prepared for further studies in science and technology

4.0: CONCLUSION:

In this unit the philosophy and objectives of basic science and technology were stated. The philosophy and objectives were organised around the principles and practice of integration. The contents were developed around themes arranged in modules.

5.0: SUMMARY

In this unit, you learnt about the followings:

- The philosophy on which BSTC was structured and organised. It is built around themes with other national and international interest. It is integrated into four topics arranged in modules.
- The five main objectives of BSTC were outlined based on the philosophy of the curriculum.

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

Abdullahi, A. (1982). Science Teaching in Nigeria. Atoto Press Ilorin

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UNIT 2: PSYCHOLOGICAL THEORIES OF LEARNING AND THEIR IMPLICATIONS IN THE TEACHING OF BASIC SCIENCE AND TECHNOLOGY CURRICULUM

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 in the organization of science lessons. These psychological theories are very essential in the execution and implementation of BSTC in the classroom.

2.0 OBJECTIVES

After studying this unit, you will be able to describe:

David Ausubel's Theory of Learning

- Jerome Brunner's Theory of Learning.
- Robert Gagne's Theory of Learning
- Jean Piaget's Theory of Learning
- Discuss the implications of these theories in the teaching and learning of BSTC.

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 stressed the value

of prior knowledge in the learners' learning process. He was of the opinion that what a student already knew could aid or hinder new learning. He pointed out that meaningful learning occurs when there is appropriate link between prior knowledge and the new learned task. When such interaction is not there rote learning occurs. He called the previous knowledge subsumer and described it as generalised knowledge that the learner already acquired that provide association or anchorage for the various components of the new knowledge. Another linkage relevant for meaningful learning is advance organiser. This involved organising the learning task in sequences from known to unknown using what is familiar to the learner and link it to the new idea. This is used where there is lack of previous knowledge. The teacher provides external linkage from where the learner will link the new knowledge. In other words, there must be set induction to get the learner ready for new knowledge meaningful learning can take place.

SELF ASSESSMENT EXERCISE 12

3.2: Differential between subsumer and advance organiser as used by Ausubel.

According to Ausubel subsumer is the previous knowledge a learner has before coming into the class which serves as a linkage to the new knowledge to be acquired. The presence of subsumer gets the learner ready for new knowledge and links learner to the new knowledge thus making learning of the new knowledge easier. Examples of subsumer are experiences gained during coaching at home, exposure to educational events. Advance organiser is an external attraction introduced by the teacher that will link the learner to the new knowledge. Examples are set inductions, learning materials.

3. 3: 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. Bruner initiated two forms of discovery processes namely assimilation and accommodation.

SELF ASSESSMENT EXERCISE 13

3.4: What are the implications of Brunner' theory to a science teacher?

Implications of Jerome Brunner's Theory to the science teacher are:

- 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.

3.5: 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. Gagne's theory believes that for the students to acquire the desired knowledge, the materials meant to be learnt must be sequentially structured so that the learning of one topic aids the learning of the next higher topic.

This invariably implies that science must be sequentially structured 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.

3.6: What are the implications of Gagne's theory of learning for a science teacher?

Implications of Gagne's theory for science teacher are:

- Content in science subjects 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.

3.2: JEAN PIAGET'S THEORY OF LEARNING

Jean Piaget is a developmental psychologist who spear-headed the study on cognitive and mental development stages. Piaget's theory emphasized that learning ability corresponds to the level of intellectual development. Piaget identified four human intellectual developmental stages as sensory-motor stage (0-2years), pre-operational stage (2-7 years), concrete operational stage (2-11 years) and formal operational stage (11-15 years)

Sensory stage (0-2 years) 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.

Pre-operational Stage (2-7years) 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.

Concrete operational 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. 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.

Formal operational stage (11-15 years) 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.

SELF ASSESSMENT EXERCISE 15

3.7: What are the implications of Jean Piaget's theory of learning for Teaching basic science and technology?

- 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

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 applications of the 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

Jerome Brunner theory of learning centres on: Learning through discovery

Robert Gagne's theory of learning states that learning of a new concepts or skills depends on mastery of pre-requisite concepts.

Jean Piaget's theory of learning emphasizes that learning ability corresponds to intellectual development and the implications of these learning theories for the teaching of BST.

6.0: TUTOR-MARKED ASSIGNMENT

Discuss how you as a science teacher will apply the ideas of any of the four psychologists in the teaching of basic science and technology in the classroom.

7.0: REFERENCES/FURTHER READIG

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Unit.3: METHODS OF TEACHING BASIC SCIENCE AND TECHNOLOGY

1.0: INTRODUCTION

In this unit you will be exposed to the different methods of teaching integrated science. 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 in delivering instruction to early science learners. The best approach is learner-centred approach as specified in the BSTC.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Outline some teaching methods appropriate for teaching Basic Science and Technology based on the learning theories studied in the previous unit.
- Examine the use of ICT as a teaching tool

3.0: MAIN CONTENT

3.1: Methods of 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. Guided inquiry is a teaching approach where the learner carries out the learning activity with the teacher as a guide. The learner from experience builds up his/her knowledge. The learner is in control of what he/she learns. Activity-based approach is the road to inquiry. All inquiry learning involves use of materials which the learner will use in the process of inquiry. Child-centred indicates that the learner is at the centre of the learning process. The learner is involved in the learning process. Some child-centred teaching methods recommended for BSTC are discussed

SELF-ASSESSMENT EXERCISE 15

3.2: What topics can the teacher teach with inquiry method?

This is the teaching approach where the learner plays the role of determining the solution to the problem. The learner is experience builds up his/her knowledge following the teachers guide. It is a structured exploration by the learner from where he/she builds up knowledge. It is child-centred approach to teaching. It helps the learner to interact with objects and thus develop science process skills.

Inquiry method can be applied in teaching all basic science and technology topics. It requires the teacher to plan ahead of what the learners will do and use for the inquiry activity.

SELF ASSESSMENT EXXERCISE 16

3.3: What it Project Method?

Project method is one of the methods recommended in the teaching of BSTC. It is a child-centred approach and inquiry based. It is learning process that gives the learner the opportunity to apply what he/she has learnt to real situation. It is a practical application of the knowledge acquired to real situation. Project is the integration of all that are learnt from BSTC to address the needs in the environment. It focuses on democracy and collaborative learning to solve purposeful problems, (Knoll, 2014). It helps the learner to develop critical thinking, manipulative skills as well as innovative, inventive and creative skills. It integrates knowing and doing (Markhams, 2011). A lot of projects are recommended in the BSTC for the students. The teacher is to guide the learners to carry out these projects.

SELF-ASSESSMENT EXECISE 17

3.4: Laboratory Method

This is an activity packed method for group or individual learner(s) targeted 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 and develop in the learner the scientific attitudes.

3.5: Can Laboratory Method be used for Teaching BST Students?

All BSTC contents are laboratory based but the teacher must always be present to guide the use of laboratory equipment and to avoid laboratory accident. It develops in students the art of being a scientist.

SELF-ASSESSMENT EXERCISE 18

3.6: Field Trip

Field trip is one of the child-centred and inquiry approaches adopted for the teaching of BSTC. 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.

3.7: Who Plans Field Trip?

The planning of field trip is the duty of the class teacher based on the lessons taught in the class and the purpose of the field trip. In planning it has to be discussed in the class with the students or pupils so as to carry them along as well as build their interest in the trip. Parents as well as the head of the school will be notified of the trip giving reasons and place for the trip as well as financial involvement.

3.8: Selecting of Teaching Method

Different teaching methods are discussed in this unit. Each teaching method is as good as the other. It depends on the teacher to select the method suitable for the topic to be taught. Two teaching methods can be combined in teaching a topic. There are many other methods like lecture, discussion, play method and so on.

SELF ASSESSMENT EXERCISE 19

3.9: What Criteria can You Apply in Selecting Teaching Method for a Topic?

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.

(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.

(iv). Resources available: Availability of resources helps on selecting teaching method.

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

SELF-ASSESSMENT EXERCISE 19

3.10: Information Communication Technology (ICT) as a Teaching Tool in Basic Science and Technology Curriculum

As stated in National Policy of Education (2014) government proposed that integration of ICT into education in Nigeria begins from primary school. Igbokwe (2015) included ICT as one of the major teaching tools for BSTC. 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. 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.

3.10: Is ICT Relevant in Teaching BST Topics?

ICT is relevant in teaching BST topics. Its advantages abound. It addresses most of the problems of teaching such as class size, lack of qualified teachers. The zooming packages which is used in conferencing and distant discussion was very useful during COVID-19 for lectures and teaching. Many institution versed in ICT did not lose any academic session because of COVID-19. There are many other relevance of ICT in teaching BST topics.

4.0: CONCLUSION

No single teaching method is exceptionally the best for teaching Basic Science and Technology. However, child-centred 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 teacher combines two or more methods 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. The use and importance of ICT as a teaching tool and 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.

7.0: REFERENCES/FURTHER READING

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UNIT.4: RESOURCES FOR TEACHING BASIC SCIENCE AND TECHNOLOGY CURRICULUM

1.0: INTRODUCTION

In the previous unit you studied the different methods for teaching BST. In this unit you examine the resources materials for teaching BSTC. Resources materials are medium of instruction between the teacher and the learner. They are concrete materials the teacher uses to communicate ideas to the learner.

The emphasis on environmental resources is clearly illustrated in 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 (2012) in accordance with FGN (1985) suggests the use local materials for teaching BSTC

which 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 process of improvisation for teaching and producing resource materials for Basic Science and Technology.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Discuss the different types of resource material for teaching Basic Science and Technology.
- Provide resource materials for teaching BSTC.

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 teaching and learning process of Basic Science and Technology Curriculum. They are human resources, materials resources and financial resources.

SELF-ASSESSMENT EXERCISE 20

3.2: What are human resources?

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 workers, parents, scientists, local craftsman who may be 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 recommended a range of human resources for teaching it.

SELF-ASSESSMENT EXERCISE 21

3.3: What are material resources for teaching BSTC?

Material resources are materials found in nature that can be used for practical. Materials resources abound such as wood, glass, rocks, chemicals, living things and non-living things. 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 used to solve the problems related to them in the society.

SELF ASSESSMENT EXERCISE 22

3.4: What the Financial Resources?

These are materials that are bought either from factory, market or imported. They are not improvised materials. They are conventional materials, standardised and can withstand all environmental conditions

3.5: IMPROVISATION

National Policy on Education for basic education emphasized much on improvisation of materials for teaching of Basic Science and Technology. It is an art of the teacher to provide alternative learning materials 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-centred instructional process because students are involved in improvisation. One characteristics of improvisation is that it uses local materials from the environment of the learner to produce the material needed for teaching. This introduced local milieu in the learning process. Improvisation though very important in teaching and learning is time consuming and costly. But it develops in student skills of invention, removes the abstract nature of science and bring in cultural milieu of the learner in science. Holdhus, Hoisaeter and Mallard (2016) explained improvisation as basic tool for learning science.

SELF ASSESSMENT EXERCISE 23

3.6: Outline the Process You Will Use in Improvising Material for Teaching

The teacher will outline the materials needed for the selected topics. Instruct the students to come to school the following day with the materials of different type collected from their environment. The teacher uses the materials from the students to build a nature corner. As the teaching is going on the teacher collects the materials for teaching from the nature corner. At the end of the lesson give them assignment to come to school for science with other sets of materials. This will enrich the nature corner and learning as well.

4.0: CONCLUSION

It is at the heart of Basic Science and Technology curriculum that it be taught using varied types of resource materials from the students' environment. Local 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 their 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 basic science and technology programme to talk to your students on scientific issues of the time such as HIV/AIDS, drug abuse.

7.0: REFERENCES/FURTHER READING

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MODULE 3: TECHNIQUES FOR TEACHING INTEGRATED SCIENCE

Unit 1: Planning for BST Teaching

Unit 2: Integrated Science Laboratory, design, Safety and Management

Unit 3: Evaluation Procedures for Outcomes of BST Programme

INTRODUCTION

The concern of this module is to expose you to the techniques for teaching BST topics. The philosophy and objectives BSTC are already treated. This helps you to know the stated objectives. The modular arrangement will help you to develop the scheme of work from the curriculum, build the lesson plans and lesson notes. This module will expose you on how to manage and the safety precautions in the use of integrated science laboratory, its organization and safety. The module will also expose you to different evaluations methods for the learning outcomes. The module is divided into three 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 pre-requisite documents the teacher will develop from the curriculum in preparation for BST teaching namely the syllabus, scheme of work and lesson plan.

2.0: OBJECTIVES

After studying this unit, you should be able to:

- Develop the syllabus for BST
- Develop BST scheme of work from the curriculum document
- Prepare lesson plan for BST topic

3.0: MAIN CONTENTS

3.1: Syllabus

The first consideration by a teacher is to look at the BST curriculum, read the philosophy and objectives of the curriculum as well as the activities outlined for each topic. It is from the curriculum that the teacher will develop class syllabus, scheme of work and lesson plan.

SELF ASSESSMENT EXERCISE 24

3.2: Plan a Syllabus of JSS 1 for first Term Syllabus

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 to be done in each class at each school level in BSTC. It is arranged in a logical, spirally sequence for the period of 9-years of basic science and technology education. The syllabus takes into account:

- The depth of coverage of the topic at each level
- Sequence treatment of topics by moving from known to unknown indicating the topics that require more time.
- Guidelines for method of teaching
- Reference and materials needed for each topic.

In doing this the teacher considers the following

- Looks at the topics for the term
- Considers the number of weeks in a term

- Checks the number of time the topics come in the school time table.
- Considers the resource materials to be used
- Considers the methods suitable for teaching the topics

With these at the teacher's disposal he/she will arrange the topics in sequence from known to unknown till the whole topics are fixed up showing number of times each is taught, materials to use and method to be used so that any teacher picking the syllabus can easily continue from where the last teacher stopped.

SELF-ASSESSMENT EXERCISE 25

3.4: Map out the scheme of work for the second week of first 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 each day. 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):

- 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 26

3.5: Write a format for a lesson plan for second day in the first week of the first term.

Lesson plan is a daily guide to the teacher. It is a guide to the teacher in presenting a good and effective BST lesson 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- JSS1

Date- 17/9/91

Unit- Living Things in the Environment

Topic- Plants and Animals

Average age- 9 years

Time of learning- 9.05am to 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.

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

- Name three different with their proper biological names
- Name three animals with their proper names
- Differentiate between the plants and animals
- Explain the different characteristics of animals and plants.

Resources: This explains the type of materials the teacher thinks are suitable for the topic and age of the learner. The teacher may ask the students to come to school with different types of plants while the teacher brings into the class some animals or drawings of them

Introduction: This is the set induction or manner the teacher finds suitable to use in introducing the topic.

Learning Activities: This shows step by step presentation of the topic to Students. What the teacher will do and what the students will do. The styles of interacting of the teacher with the students.

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.

4.0: CONCLUSION

In this unit, you learnt how to prepare the syllabus, scheme of work and lesson plan and be able to differentiate one from the other.

5.0: SUMMARY

In this unit, you are exposed on how to build the syllabus from the curriculum, develop the scheme of work from the syllabus and write lesson plan for the daily teaching topics.

- 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

1.0: INTRODUCTION

Laboratory is an integral part of science education. Integrated Science has its laboratory as stipulated by NUC Benchmark for the teaching of integrated science.

Just as there is biology, chemistry and physics laboratory, there is the 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 for week are kept. This changed according topics. It is not permanent in the sense that the materials will be kept there for months.

2.0: OBJECTIVES

After studying this unit, you would be able to:

- Set up an integrated science laboratory
- Describe and set up a nature corner
- Explain the design of an integrated science laboratory
- Discuss the safety standard for integrated science laboratory.
- Manage an integrated science laboratory

3.0: MAIN CONTENT

3.1: 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 27

3.2: 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 from their environment for teaching are also used to build the Nature Corner. The materials of the nature are set up based on the topic to be taught. It is removed when they are not relevant to the next topic. Dangerous materials are not to be kept in the nature corner such as wild animal or sharp objects. These are removed as soon as the teacher finished using them. 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-centred because the students are involved in the building of the Nature Corner.

SELF-ASSESMENT EXERCISE 28

3.3: What will be the design of an integrated science laboratory?

As earlier said, integrated science must have laboratory. It consists of a lager hall well ventilated and lighted equipped with laboratory benches fixed with Bunsen 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 29

3.4: 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 and used ones. The technologist gets materials ready for the integrated science teacher and helps the teacher to teach technology topics that unites other sciences. 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 are 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 30

3.5: What type of accidents can occur 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 rules 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 Programme

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
- Understand the importance of Project-based assessment BSTC

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 counselling tools for the teacher, guidance counsellors, 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 31

3.2: Explain the Different Forms of Tests

Test is an assessment model for determining students' learning outcome in a subject at mid-term or at the end of a session or after a topic is taught. A test most be valid and 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 3 2

3.3: Outline the Principles of Test Construction in Integrated Science.

In constructing a test, the following points are considered:

- Identification of major concepts to be teste

- 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	Knowled Ge	Compreh ensive	Applicatio n	Analysis	Synthesis	Evaluation	Total
Family Traits	2	1	1	0	0	0	4
Environmen tal 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 33

3.4: 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 person 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 carry high mark.

SELF-ASSESSMENT EXERCISE 34

3.5: 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 is an 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

6.1: Differentiate between low and high cognitive live in Bloom Specification

6.2: Provide a project for your students for JET Competition.

7.0: REFERENCES/FURTHR READINGS

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