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COURSE TITLE: NIGERIAN INTEGRATED SCIENCE CURRICULUM

COURSE GUIDE

SED 225
NIGERIAN INTEGRATED SCIENCE CURRICULUM

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MODULE 1 DIFFICULT TOPICS/UNITS IN NIGERIAN INTEGRATED SCIENCE CURRICULUM

UNIT 1 THE DESIGN AND STRUCTURE OF THE NIGERIAN INTEGRATED SCIENCE CURRICULUM

CONTENTS

1.0 INTRODUCTION

The Integrated Science curriculum is child centered and emphasis is laid on learning science as a process than as a body of knowledge. To enable integrated science to be taught logically, what you have to teach, why you have to teach it and how you have to teach it, have all been put into the integrated science curriculum. In this unit, you are going to learn about the design objectives, structure and contents of the integrated science curriculum.

2.0 OBJECTIVES

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

- describe the design of integrated science curriculum;
- describe the structure of the integrated science curriculum;
- identify problems encountered in using the curriculum
- mention some solutions to the problems

3.0 MAIN CONTENT

3.1 Design, Objectives and Structure of Integrated Science Curriculum

The general objective of integrated science education is to enable pupils observe and explore the environment using the senses of their hands. The design of the curriculum is based on the spirality of themes which are arranged from year 1 to year 6 and JSS I to 3.
The content was organized using the thematic approach.
Theme 1: you and environment
Theme 2: living and non – living things
Theme 3: you and technology
Theme 4: you and Energy

The spiral nature of the themes ensures that contents become gradually difficult as learners progress from primary 1 to 6 and from JS 1 to JS 3. Some emerging issues, such as value orientation, peace and dialogue, human right education, family life, HIV and AIDs education and entrepreneurial skills were infused into the relevant contents.

For each year, a main topic is given along with performance objectives, the contents, teacher and pupils' activities, materials and evaluation guide.

SELF-ASSESSMENT EXERCISE

What is the importance of the spiral nature of the curriculum?

Theme F: You and Environment

Topic	Performa-nce objectives	Contents	Activities		Teaching and learning materials	Evaluation guide
			Teacher	Students		
Air pollution	Students should be able to: 1. define air pollution 2. list some air pollutants 3. identify sources of air pollution 4. discuss the effects of air pollution 5. discuss the different methods of pollution control	1. definition of air pollution 2. sources of air pollution 3. consequences of air pollution 4. control measures	1. leads discussion on air pollution and its effects 2. arrange a class visit to a nearby factory or industry 3. class charts, films and pictures to guide class on the consequences and control measures	1. participate in discussion 2. visit a factory and take notes 3. watch pictures on air pollution	1. films 2. charts 3. pictures on pollution	Students to: 1. define air pollution 2. name 3 air pollutants 3. list 3 sources of air pollution 4. discuss the effects of air pollutants from a factory on the people and environments near it. 5. state two ways of controlling air pollution

Problems of Curriculum Implementation

Certain problems you may encounter in implementing the integrated science curriculum include:

1. inadequate supply of curriculum modules
2. inability to meaningfully interprets the performance objectives
3. skipping unfamiliar content areas
4. inability to organize activity for the students
5. skipping activities where materials are not readily available
6. inability to identify sources of teaching aids
7. lack of assessment skills
8. rush to finish the scheme of work

Solutions to the problems

Some of the solutions to the problems include

1. seek assistance of more experienced teachers
2. obtain information about resources for integrated science as given in module 2 unit 8

3. you as the integrated science teacher must read on your own and become familiar with the different content areas

SELF-ASSESSMENT EXERCISE

List the problems one can encounter in implementing the curriculum and proffer solutions

5.0 SUMMARY

In this unit, you have learnt about the design, objectives and structure of the integrated science curriculum. You have also learnt about the problems and challenges in implementing the curriculum and the possible solutions.

6.0 TUTOR-MARKED ASSIGNMENT

i. List the themes of the integrated science curriculum.
ii. Mention 2 problems one may encounter in implementing of the curriculum.
iii. How would you solve the problems in questions?

7.0 REFERENCES/FURTHER READING

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UNIT 2 REVIEW OF THE NIGERIAN INTEGRATED SCIENCE CURRICULUM

CONTENTS

1.0 INTRODUCTION

The Nigerian Integrated Science Curriculum has come a long way, moving from Nature study through General Science to Integrated Science through various transformations and Integrations of the science. In the past four decades, there have been changes in the nature of science taught in schools. Science has become more integrated and emphasis has been on products and the processes of sciences.

In unit one, we discussed the design and structure of the curriculum. In this unit we are going to look critically at the curriculum to see the reviews relevant to national development in line with global and national demand.

2.0 OBJECTIVES

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

- Give at least two reasons for curriculum review
- Mention the new nomenclature for integrated science and primary science
- List the themes infused into the integrated science curriculum
- Mention the goals of the curriculum reform
- Mention some importance of the curriculum reform

3.0 MAIN CONTENT

3.1 Why Curriculum Review?

Functional education is determined by the quality of the curriculum content and its implementation. Functional curriculum content must be valid, significant, learnable and consistent with social realities, useful and reflect the interest of the learner (Offorma, 2005). Valid curriculum content must be related to the philosophy and objectives of education. The Nigerian Integrated Science Curriculum planners and developers attempted to take care of the issues mentioned above, but there are factors militating against the attainment of the goals of education.
Such factors include:

- Curriculum overload
- Overcrowded classrooms
- Poor method of instruction
- Lack of adequate laboratories and equipment

Curriculum review became important as a result of the Federal Government of Nigeria's decision to introduce the 9 years of Basic Education and the need to attain the Millennium Development Goals (MDGs) by the year 2015.

This is together with the need to meet the critical targets of the National Economic Empowerment and Development Strategies (NEEDS). It then became obvious that the existing curriculum for Junior Secondary School should be reviewed, restructured and re-aligned to fit into a 9 year of Basic Education.

The national Council on Education in 2005 directed the Nigerian Educational Research and Development Council (NERDC) to carry out the review, restricting and re-alignment.

The National Council on Education also approved the new curriculums as Basic Education Curricula. Consequently a high level policy committee on curriculum development met and produced the guidelines for the curricula restructuring (Dauda & Udofia, 2010).

SELF-ASSESSMENT EXERCISE

What are the factors militating against the attainment of the goals of education in Nigeria.

3.2 The Reviewed Curricula

The Nigerian Educational Research and Development Council (NERDC) convened a meeting of experts from various fields in 2006, who met and produced the reviewed curricula. In the re-structuring, Basic Science and Technology replaced Integrated Science while Basic Science replaced Primary Science.

SELF-ASSESSMENT EXERCISE

Give the new names for Integrated Science and Primary Science.

3.3 Goals of the Curricula reform

The goals of the curricula reform were to reflect depth, appropriateness and inter-relatedness of the curricula content in line with this goal; the following themes were infused into the Integrated Science Curriculum to form the Basic Science Curriculum

- Environmental Education
- Drug Abuse Education
- Population and Family Life Education
- Sexually Transmitted Infections (STI) including HIV/AIDS (FRN 2006)

Whereas Integrated science is science presented to the child such that the child gains the concept of the fundamental unity of science, the commonality of approach to problems of scientific nature and the understanding of the role and function of science in everyday life and the world in which we live (FRN 1984). Basic Science and Technology is basic training in scientific skills required for human survival, sustainable development and societal transformation.

3.4 Importance of Curriculum Review

The fundamental aim of Nigerian Integrated Science project is to develop in students science process skills. Because of lack of adequate laboratories and equipment and other factors such as poor method of instruction, students are often not confronted with first hand concrete experience. Ajagun (1990) has the view that the problem of Integrated Science can be solved or minimized by changing the method of teaching the subject. According to Yashin (1991), science processes are hardly assessed in the Nigerian Secondary School. Most children are not exposed to hands on process and skills acquisition in our schools as specified by the curriculum. Hence curriculum review becomes very

imperative to make the curriculum relevant to national development in line with the global and national demand.

SELF-ASSESSMENT EXERCISE

What is the importance of curriculum review?

4.0 CONCLUSION

5.0 SUMMARY

In this unit you learnt that curriculum review was necessary because functional education is determined by the quality of the curriculum. The curriculum review became imperative because of the Federal Government of Nigeria's decision to introduce the 9 years of Basic Education. The restructuring brought about the change of Integrated Science to Basic Science and Technology and Primary Science to Basic Science. The new themes infused into the Integrated Science Curriculum were Environmental Education, Drug Abuse Education, Population and Family Life Education and Sexually Transmitted Infections (STI) including HIV/AIDS. The curriculum review will ensure that students develop science process skills.

6.0 TUTOR-MARKED ASSIGNMENT

i. What are the new themes infused into the integrated science curriculum?
ii. Differentiate between Integrated Science and Basic Science and Technology.

7.0 REFERENCES/FURTHER READING

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UNIT 3 SCIENTIFIC ATTITUDES

CONTENTS

1.0 INTRODUCTION

Cognitive or intellectual skills are not only skills that bring about changes in education. Changes can also be achieved through affective orientations. The awareness of the role of affective variables in shaping our society has led in recent times to the practice of specifying the desirable attitudes and interests to be achieved through planned educational programmes. The nature of attitude implies that it is, apart from intellectual preparedness, the basis of motivation in learning. In planning curriculum for children preferred attitudes and evaluation of attitudes must be included.

According to Ebel (1972), feeling is as real and as important a part of our human nature as much as knowing. How a person feels is almost always more important to him than what he knows; how he behaves is almost always more important to others than what he knows. There is, therefore, much to measure attitudes and interests as there is to assess cognitive outcomes of education. In this unit, we are going to discuss the attitudes that scientists have that enable them to carry out scientific investigations and researches

2.0 OBJECTIVES

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

- define scientific attitude,
- mention the attributes of scientific attribute and
- describe the attributes

3.0 MAIN CONTENT

3.1 Scientific Attitude.

There are several definitions of scientific attitude.
Moore & Sutman (1970) defined Scientific Attitude as an opinion or position taken with respect to a psychological object in the field of science. Billeh & Zakhariades (1975) defined Scientific Attitude by six categories, rationality, curiosity, open-mindedness, aversion to superstition, objectivity, intellectual honesty, and suspended judgment. These categories contain both intellectual and emotional or affective element proposed by Moore & Sutman but deal more directly with dispositions that facilitate an understanding and interpretation of method as well as knowledge of science as distinct from dispositions toward issues concerning science.

Kozlow & Nay (1976) proposed 8 attitudes, critical mindedness, suspended judgment, respect for evidence, honesty, objectivity willingness to change opinion open mindedness and questioning attitude. A scientific attitude is an approach to investigations that benefit from certain traits which are learned attitudes or categories as we saw above.
Gauld and Hukins (2002) in their own definition said that scientific attitudes are a composite of a number of mental habits, or tendencies to react consistently in certain ways to a novel or problematic situation.

SELF-ASSESSMENT EXERCISE

With many relevant examples, explain the concept of attitude.

3.2 Attributes of Scientific Attitude

Scientific attitude has divisions and subdivisions which can be referred to as attributes. Some people also refer to them as categories. Both attributes and categories mean the something. There are attitudes that scientists always display when carrying out scientific investigations. These attributes can be five, eight, ten or even twenty depending on who is listing them. Billeh & Zakhariades (1976) identified five categories which are: rationality, curiosity, open mindedness, objectivity and aversion to superstition

Kozlow & Nay (1976) proposed eight attributes: critical mindedness, suspended judgment, and respect for evidence, honesty, and objectivity, willingness to change opinion, open mindedness and questioning

attitude. Pudlao (2012) listed ten scientific attitudes as belief, curiosity, objectivity, skepticism, open mindedness, creativity, risk taking, honesty, humility and responsibility. You will discover that some of the attributes are common to all the scientists and some are subsumed under others. They are all attributes that make up scientific attitude.

We will now learn the explanations of the different attributes.

1. **Belief:** A scientist believes that everything that happens in this world has a cause or reason. A scientist rejects superstitious beliefs and prefers scientific explanations
2. **Curiosity:** A scientist shows interest and pays particular attention to objects or events. He asks questions and seeks answers.
3. **Objectivity:** A scientist is objective if he does not allow his feelings and biases to influence his recording of observations, interpretation of data and formulation of conclusions.
4. **Skepticism (Critical Mindedness):** A scientist bases suggestions and conclusions on evidence. When in doubt, he questions the veracity of a statement in relation to the pieces of evidence presented.
5. **Open-Mindedness:** A Scientist listens and respects the ideas of others. He accepts criticism and changes his mind if reliable evidence contradicts his belief.
6. **Creativity (Inventiveness):** A scientist can generate new and original ideas
7. **Risk taking:** A Scientist expresses his opinions and tries new ideas even at the risk of failure or criticism.
8. **Intellectual Honesty:** A scientist gives a truthful report of observations. He does not withhold important information, just to please himself or others.
9. **Humility:** A scientist is humble when he admits that he is not free from committing errors. He recognizes that there may be better ideas and realizes that there are individuals whom he may have to consult to arrive at correct observations and conclusions.
10. **Responsibility:** A scientist actively participates in a task and also dutifully performs tasks assigned to him.

SELF-ASSESSMENT EXERCISE

List any 10 attributes that constitute scientific attitude and explain each briefly.

Over the years a number of other attributes have been discovered to make up scientific attitude. You will discover that they are divisions or subsets of the original attributes we have described above
Such attributes are:

1. **Empiricism:** A scientist prefers to look and see, you do not argue whether it is raining outside, you just stick a hand out of the window.
2. **Determinism:** "cause and effect'' underlie everything. An action causes a reaction and effects do not occur without causes, a belief that problems have solutions and that major problems have been tackled in the past.
3. **Parsimony:** Prefer the simple to the complex
4. **Scientific manipulation:** Any idea must usually be confirmed by work
5. **Skepticism:** Nearly all statement, make assumptions of prior conditions. A scientist must often go back and determine if all the assumptions made are true to how the world operates
6. **Precision:** Scientists are very exact and picky
7. **Respect for Paradigms:** A paradigm is our overall understanding about how the world works. Does a concept fit with our overall understanding or does it fail to weave in with our broad knowledge of the world.
8. **A respect for power of theoretical structure:** No sciencetific facts are accumulated at random
9. **Willingness to change Opinion:** Always ready to acknowledge when wrong
10. **Loyalty to reality:** Scientists are always concerned about reality
11. **Aversion to superstition and automatic preference for scientific explanation:** a Scientist rejects superstition and prefers paradigms.
12. **A thirst for knowledge, and intellectual drive:** Scientists are addicted puzzle solvers.
13. **Suspended judgment:** A scientist tries hard not to form an opinion on a given issue until he has investigated it.
14. **Awareness of assumptions:** a good scientist starts by defining terms and making all assumptions very clear
15. Ability to separate fundamental concepts from the irrelevant or unimportant
16. Respect for quantification and appreciation of mathematics as a language of science
17. **An appreciation of probability and statistics:** People who have little experience with statistics will have difficulty understanding the concept of an event occurring by chance.

18. **And understanding that all knowledge has tolerance limits:** There is no absolute certainty
19. **Empathy for the human condition:** there is a value system in science and it is based on human being the only organisms that can imagine things that are not triggered by stimuli present at the immediate time in their environment (Culled from The Kansas School of Naturalist Vol. 35, No 4, April 1989 www.ksu.edu/biology/modern attitudes.html).

3.3 Importance of Scientific Attitude in the Classroom

Attitude has been viewed as the disposition to respond positively or negatively toward an object or phenomena. One of the important goals of science teaching is to promote positive attitudes towards science. Students with positive feelings towards science achieve more and also more likely to incorporate science into their daily lives when they appreciate its importance (Simpson & Anderson (1981). Creat achievement in both the cognitive and psychomotor domains to a large extent depends on the affective domain; Canin & Sund (1975) posited that the degree to which scientific attitudes are manifested by the scientist as he carries out his investigation determines how well he will be able to utilize the processes to make significant discoveries.

3.4 Development of Scientific Attitude in Students Using Activity Based Approach

To develop scientific attitude in students, they should be provided with hands on experiences. (Simpson & Anderson, 1981; Nzeiri 2008; Nwosu, 2008). Activity based approaches provide students with hands on experiences. Any teaching strategy in which students are involved in activities be it in exercise, laboratory work or lets find out exercises/activities is activity based approach.

SELF-ASSESSMENT EXERCISE

What are activity based approaches? Cite and explain two relevant examples.

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you learnt that scientific attitudes are a composite of a number of mental habits, or tendencies to react consistently in certain ways to a novel or problematic situation. You learnt that scientific attitudes include belief, curiosity, objectivity skepticism, open

mindedness, creativity, risk taking, honesty, humility, and responsibility. These attributes were also described. You learnt also about the importance of scientific attitudes in the classroom and the method to be used in developing scientific attitude in students.

6.0 TUTOR-MARKED ASSIGNMENT

Describe the ten attributes of scientific Attitude

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UNIT 4 SCIENCE PROCESS SKILLS

CONTENTS

1.0 INTRODUCTION

Many science educators have written about process skills or intellectual skills. Among these, the views of Gagne (1968) as cited in (Ekpunobi, (2007) have been most influential. In his theory of learning structure, learning hierarchy and learning pre-requisite, he submitted that pre-requisite knowledge for learning the concepts and principles in the hierarchy can be obtained only if the students have acquired contain underlying capabilities. These capabilities he called intellectual skills or science processes which are needed by students to practice and understand science.

Science A Process Approach (SAPA), the Gagne influenced American Association for the Advancement of science (AAAS) curriculum identified sixteen of such skills that the curriculum aimed to develop in pupils exposed to it. In this unit we are going to study the process skills and how it is used in the integrated science classroom.

2.0 OBJECTIVES

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

- explain what science process skills are;
- mention the two levels of science process skills;
- list the basic process skills;
- list the integrated process skills;
- describe at least five of science process skills;

3.0 MAIN CONTENT

3.1 Science Process Skills

Science process skills are defined as a set of broadly transferable abilities and reflective of the behaviors of scientists. According to Nwosu & Okeke (1995), science process skills are the skills and strategies both mental and physical that scientists use to carry out the processes of doing science. The processes are underlying capabilities which are needed to practice and understand science. The scientific method, scientific thinking and critical thinking have been the terms used at various times to describe these science skills. Today the term "Science Process Skills" is commonly used.

SELF-ASSESSMENT EXERCISE

What are the science process skills?

3.2 Types of Process skills

SAPA grouped the process skills into two types:
1. Basic process skills
2. Integrated Process skills

3.2.1 Basic Science Process skills

The basic science process skills provide a foundation for learning the more complex integrated skills.
These skills are listed and described below:

1. **Observing:** using the senses to gather information about an object or event. Observing is the fundamental science process skill. We observe objects and events, using the five senses, and this is how we learn about the world around us. The ability to make good observation is essential to the development of the other science process skills. The simplest observations, made using only the senses, are **qualitative_Observations**. For example, the ball is blue, the leaf is green in colour. Observations that involve a number or quantity are called **quantitative observations**. Example includes the leaves are clustered in one group, the mass of one leaf is five grains. Quantitative observations give more precise information than our senses alone.

SELF-ASSESSMENT EXERCISE

Differentiate between qualitative and quantitative observations

1) **Communicating:** using words or graphic symbols to describe an action, object or event. Communication goes hand in hand with observation. Students have to communicate in order to share their observation with someone else. To communicate effectively one must use referent ie. References to items that the other person is already familiar with. Example, we can use sky blue, grass green or lemon yellow to describe shades of blue, green and yellow. Another example of communication is describing the change in height of a child over time in writing or through a graph.
2) **Measuring:** using both standard and non standard measures or estimate to describe the dimension of an object or event. Measuring is just a special case of observing and communicating. When we measure, we compare the property to a defined referent called a unit. A measurement statement contains two parts, a number to tell us how much or how many, and a name for the unit to tell us how much of what. The use of the number makes measurement a quantitative observation.
   Example: using a meter stick to measure the length of a chair in centimeters.
3) **Classifying:** Grouping or ordering objects or events into criteria. Students are expected to be able to sort objects into groups based on their observation. Grouping objects or events is a way of imposing order based on similarities, differences and interrelationships. Classifying is an important step towards a better understanding of the different objects and events in the world.

There are several methods of classification

- **Several ordering:** objects are placed into rank order based on some property. Example, students can be serial order according to height
- **Binary classification:** A set of objects is simply divided into two subsets. For example animals can be divided into those with backbones and those without backbones.
- **Multistage Classification:** This is constructed by performing consecutive binary classification on a set of objects and then on each of the ensuring subsets. This results in a classification system consisting of layers or stages. Example: classification of the animal and plant kingdoms.

2. **Inferring:** Making an "educated guess" about an object or event based on previously gathered data or information. Inferences are explanations or interpretations that follow from observations. For example, it is an observation to say a frog released a white poisonous liquid from its skin, and it is an inference to state, the frog released a white poisonous liquid from its skin, because it is upset and trying to defend itself. When we are able to make inferences and interpret and explain events around us, we have a better appreciation of the environment around us. Scientists hypothesize about why events happen. What they do are based on inferences regarding investigations.
3. **Predicting:** Stating the outcome of a future event based on a pattern of evidence, in prediction, we are forecasting future observations. The ability to make predications about future events allows us to successfully interact with the environment around us. Prediction is based on both good observation and inferences made about observed events. Like inferences, predictions are based on both what we observe and also our past experience, the mental models we have built up from those experiences. Predictions are not just guesses, they are based on our inferences or hypotheses, if the prediction turns out to be correct then we have greater confidence in our inference/hypothesis. This is the basis of the scientific process used by scientists who are asking and answering questions by integrating together the six basic science process skills.

SELF-ASSESSMENT EXERCISE

Give examples of process skills of inferring, measuring and classifyin

3.2.2 Integrated Science Process Skills

The integrated science process skills are more complex skills than the basic skills. These skills are listed and described below:

1. **Controlling Variables:** being able to identify variables that can affect an experimental outcome, keeping most constant, while manipulating only the independent variable.

Example: realizing through past experiences that amount of light and water need to be controlled when testing to see how the addition of organic matter affects the growth of maize.

2. **Defining Operationally:** stating how to measure a variable in an experiment.

Example: stating that maize growth will be measured in centimeter per week.

3. **Formulating hypotheses:** stating the expected outcome of an experiment.
   Example: the greater the amount of organic matter added to the soil, the greater the maize growth.
4. **Interpreting data:** Organizing data and drawing conclusions from it. Example: recording data from the experiment on maize growth in a data table and forming a conclusion which relates trends in the data to variables.
5. **Experimenting:** being able to conduct an experiment, including asking appropriate question, stating a hypothesis, identifying and controlling variables, operationally defining those variables, designing a fair experiment, conducting the experiment and interpreting the results of the experiment. Example: the entire process of conducting the experiment on the effect of organic matter on the growth of maize plant.
6. **Formulating models:** creating a mental or physical model of a process or event.
   Example: The model of how the processes of evaporation and condensation interrelate in the water cycle.

SELF-ASSESSMENT EXERCISE

Describe the science process skills of defining operationally and formulating models

3.3 Learning the Basic Science Process Skills

Numerous research projects have acquisition of basic process skills. For example, Padilla, Cronin & Twiest (1985) found that teaching increases levels of skill performance. It can be concluded that basic skills can be taught and that when learned, can be readily transferred to new situations (Tomera 1974). Studies focusing on the Science Curriculum Improvement Study (SCIS) and SAPA have indicated that elementary school students if taught process skills abilities, not only learn to use these processes but also retain them for future use. Hence students learn the basic skills better if they are considered an important object of instruction and if proven teaching methods are used.

3.4 Learning Integrated Science Process Skills

Several studies have investigated the learning of integrated science process skills. Padilla, Okey & Garrard (1984) after series of experiments had results which indicated that the more complex process skills cannot be learned within a short period but over a long period of time.

3.5 Teaching Science Process Skills

Teaching strategies which proved effective in the teaching of process skills were:

1. Applying a set of specific clues for predicting.
2. Using activities and pencil and paper simulations to teach graphing and
3. Using a combination of explaining, practice with objects, discussions and feedback with observing.

In teaching process skills, teachers should select curricula which emphasize science process skills. Teachers also need to be patient especially with students that have difficulties in acquiring process skills. This is because there is need to have developed formal thinking patterns to successfully experiment.

SELF-ASSESSMENT EXERCISE

Mention the teaching strategies which proved effective in the teaching of process skills.

3.6 Importance of Science Process Skills

Science Process Skills form the foundation for scientific methods. Since science is about asking questions and finding answers, science process skills are the same skills that we all use in our daily lives as we try to answer everyday questions.

When we teach our students to use process skills, we are also teaching them skills in every area of their lives. Science process skills are integrated together when scientists design and carry out experiments or in everyday life when we all carry out experiments. All the process skills are important individually as well as when they are integrated together. Successfully integrating the science process skills with classroom lessons and field investigations will make the learning experiences richer and more meaningful for students. Students will also be learning the skills of science as well as science content. The students will be actively engaged with the science they are learning and thus reach a deeper understanding of the content. Active engagement with science will likely make students to become more interested and have more positive attitude towards science.

4.0 CONCLUSION

5.0 SUMMARY

In this unit you learnt that:

- Science Process Skills are the skills and strategies that scientists use to carry out the processes of doing science.
- There are two type of process skills, basic process skills or low order skills and integrated skills or higher order skills.
- Basic process skills are observing, inferring, measuring, communicating, classifying and predicting
- Integrated process skills are controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting and formulating models.
- Students when taught basic process skills, not only learn them, they also retain them for future use
- Integrated science process skills which are more complex cannot be learned within a short period but over a long period of time.
- Teachers should always select curricula which emphasis process skills, in teaching process skills.

6.0 TUTOR-MARKED ASSIGNMENT

Why are science process skills necessary for successful scientific work?

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UNIT 5 SCIENTIFIC INVESTIGATIONS

CONTENTS

1.0 INTRODUCTION

Science as we all know is the act of doing or learning activities through observations and experimentation that provide way for further investigation of knowledge generated through the observations and experimentations. It is an action undertaken by human beings to consider and find explanation for materials and force of nature. Individual scientists approache scientific problems in different ways, but there are certain steps that may be common to them. These steps, according to Abdullahi (1982), are regarded as scientific methods and are identified below:

1. The recognition of a problem
2. The collection of relevant information
3. The formulation of a working hypothesis
4. The making of deductions from the hypothesis
5. The testing of actual experimentation of deductions
6. Depending on the outcome or results of the experiment, the working hypothesis is accepted, modified or rejected. Scientific investigation is carried out through the scientific method.

Therefore, it implies that everybody engaged in scientific investigation of any sort will perform all these operations in varying order.

In this unit, we are going to discuss scientific investigation and learn how scientists carry out investigation.

2.0 OBJECTIVES

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

- define scientific investigation;
- describe patterns of scientific investigation;
- mention steps for scientific investigation;
- communicate scientific investigation

3.0 MAIN CONTENT

3.1 Scientific Investigation

Scientific investigation is the way in which scientists and researchers use a systematic approach to answer questions about the world around us. It is basically the study of a question using the scientific method. It includes a question or a problem, some research to learn about your questions or problem, a prediction or hypothesis, an experiment, testing your hypothesis, organizing data and finally a conclusion.

Scientific investigation follows methodical procedures to produce reliable experimental evidence. In scientific investigation, a hypothesis is normally used. This hypothesis is a question with inductive reasoning asked in a way to gather data about the nature of things in a controlled manner. The hypothesis propose a test, experiment is carried out and data are produced that will provide justification to verify or falsify the original hypothesis.

In carrying out investigation, the scientist uses a combination of the science process skills. In unit 4, we discussed the science process skills; you may go back and study them again to refresh your memory. To be termed scientific, a method of inquiry must be based on empirical and measurable evidence, subject to specific principles of reasoning.

There is no single scientific techniques to finding solutions to problems, there are thousands and one scientific problems, but whatever technique is adopted, it should be guided or controlled by objectivity which is a characteristic of scientific disciplines.

SELF-ASSESSMENT EXERCISE

What is scientific investigation?

3.2 Patterns of Scientific Investigation

Science philosophers have two views about the nature of science which are used to describe scientific activities. The two views are

1. Deductive science reasoning.
2. Inductive science reasoning.

3.2.1 Deductive Science Reasoning,

This reasoning views science as speculative human activities which are subject to observation, critical thinking, collative imagination and intuition according to Hempel (1966), in deductive inference, conclusion is drawn from the premises. For example: All living things feed (general law) All animals are living things (statement of similar feed condition). Therefore all animals feed (conclusion). Hence deductive reasoning begins from general observation or general law to specific or conclusion.

3.2.2 Inductive Science Reasoning

This reasoning conceives science as a critical and analytical activity where concrete evidence precedes a scientific generalization. Inductive reasoning is therefore generalization to observation. Thus in an inductive inference the conclusion follows from premises with probability or uncertainty.
For example:

The probability for children who drink untreated dirty water to catch typhoid is high. Eze drank untreated dirty water (makes high probable), Eze caught typhoid.

In inductive reasoning, unlike deductive reasoning, the premise may be correct but the conclusion may be wrong. Therefore inductive science works on past experiences. According to Medewar (1969) in Ogunniyi (1986), the theory underlying induction is based on the following reasons.

1. It assumes complete and unbiased set of observations
2. It fails to distinguish between the processes of discovery and proving of general preposition as if one act of mind was sufficient for both, when in fact (and particularly in science) they are totally separate acts of mind.
3. It assumes that an orderly generalization crystallizes out of a set of a disorderly set of “unprejudiced” observations. Therefore some ideas, hypothesis or theories support what scientists claim relevant or irrelevant.

3.3 Steps for Scientific Investigation

There are several phases to a good scientific investigation. These may vary a little, but they generally include:

Step 1: Observe something of interest
Step 2: Formulate a question that can be answered in a measurable way
Step 3: Formulate a hypothesis that answers the question based on experience or research
Step 4: Set up an experiment from which data can be gathered to test the hypothesis
Step 5: Analyze the data, draw conclusions and confirm or modify the hypothesis

3.3.1 Example of Steps of Scientific Investigation

1. **Observation:** The grass is green
2. **Question:** Why is the grass green?
3. **Hypothesis:** Chlorophyll located in plant cells, causes grass to be green.

Experiment: An experiment is carried out to remove the chlorophyll from the leaves of a test plant. If all chlorophyll is removed from the leaves of a test plant, and the plant remains green, then the hypothesis will be proved false by the data. However if chlorophyll is removed from the leaves of the test plant and the plant losses its green colour, the hypothesis will be supported by the data.

The nature of today's research is to prove a hypothesis false. Experiments are designed to falsify the hypothesis by yielding evidence (data) to disprove it if evidence (data) that is gathered does support the hypothesis, the hypothesis is accepted on trial basis. It is never accepted as absolute truth. This is because future investigations may falsify the hypothesis.

SELF-ASSESSMENT EXERCISE

List the steps of scientific investigation

3.4 Communicating Scientific Investigations

Once scientists arrive at conclusions they need to communicate their findings to others. In most cases, they do so in scientific journals in a standard scientific paper format. Components of a scientific paper

include abstract, introduction, materials, results, discussion, and references.

1. **Abstract:** The abstract summarize the questions being investigated in the paper, the methods used in the experiment, the results and the conclusion drawn.
2. **Introduction:** Here you introduce the problems and questions you addressed in conducting your experiment.
3. **Materials:** Here you list all major items used to carry out your experiment, how did you set up your experiment, how many experiment groups did you have? How did you measure the effect you studied
4. **Results:** This is where you show the data that you collected. Results are usually shown in tables or graphs (figures). All figures that are presented must have a caption or title placed above it that describes its contents. Tables and figures are numbered consecutively throughout a scientific paper.
5. **Discussion:** you should critically examine your results and interpret the trends in the data. In your discussion you will try to ask questions such as, do your results support your hypothesis? Were your questions answered? What new questions come to mind after examining the results
6. **Reference:** Here you include published works that you cited in your paper. Use the standard format given in scientific writing e.g APA

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you learnt that scientific investigation is the way scientists answer questions about the world around us using the scientific method. You equally learnt that the patterns of scientific investigation are deductive science reasoning and inductive science reasoning.

In carrying out scientific investigations, the steps of observation, questioning, hypothesis, experimentation, analysis and conclusion are followed. Scientific investigations are communicated through scientific paper.

6.0 TUTOR-MARKED ASSIGNMENT

i. List the steps involved in scientific investigation
ii. Describe how you can communicate scientific investigation

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UNIT 6 INNOVATIONS IN TEACHING INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Innovations refer to changes or new ways of doing things. The concept of innovation is relative, in that what is innovative to one person or group of persons may be common place or old to another person. In the context of teaching and learning integrated science, innovation refer to creative ways which the learner is transformed from a passive receiver of knowledge into an active creator of the process in which he learns (Nacino – Brown, Oke & Brown, 1982).

Innovations in Integrated Science embrace such area as

- Innovations in curriculum structure
- Innovations in methodology
- Innovations in the teaching and learning environment
- Innovations in instructional material usage
- Innovations in the assessment of learning outcomes

There are considerable overlaps in the content of these areas because they are integral parts of the whole teaching and learning processes in science. In this unit, we are going to learn about the different innovations in the area of teaching and learning as listed above and discuss the innovations like the use of ICT in teaching science, the use of field trips and finally questioning techniques in the teaching of integrated science.

2.0 OBJECTIVES

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

- explain the concept of innovation;
- list the different aspects of innovation in Integrated Science;
- describe some of the aspects of innovation in Integrated Science;

3.0 MAIN CONTENT

3.1 Innovations in Integrated

According to Naccino – Brown, Oke & Brown, (1982), innovations refer to creative ways which the learner is transformed from a passive receiver of knowledge into an active creator of the process in which he learns. Aspects of innovations in Integrated Science include innovations in curriculum studies, innovations in methodology, innovations in the teaching and learning environment, innovations in instructional material usage, and innovations in assessment of learning outcomes.

3.1.1 Innovations in Curriculum Studies

Many changes have taken place in the area of curriculum development in science education. Oguniyi (1986), said that the process of curriculum development is perhaps the most remarkable change that has taken place in the educational system of many African countries.

The history of science teaching started with the teaching of nature study in schools. This was followed by several projects especially the ones carried out in Nigeria by the Science Teachers Association of Nigeria, which greatly influenced the curriculum.

A significant innovation in the curriculum of integrated science was the evolution of the National Policy on Education. Within the context of the National policy on Education a unifying general objectives for the teaching of science in Nigerian schools were derived. These include providing opportunity to manipulate and experiment with suitable

equipment and resources in a situation encouraging social interaction. The Integrated Science Curriculum has been structured to become more relevant to the needs of the child and the society in which it is intended

SELF-ASSESSMENT EXERCISE

What is the general objective for the teaching of Integrated Science?

3.1.2 Innovations in Integrated Science Methodology

The contributions of psychologists such as Jean Piaget (Theory of Cognitive Development), Robert Gagne (Learning Hierarchies), Jerome Bruner (Learning by Discovery) David Ausubel (Meaning Verbal Learning) have greatly increased our knowledge of children, their cognitive development and learning styles. These and our knowledge of philosophy of science have made it possible for us to develop new methods and approaches. These methods and approaches include

- The inquiry/problem solving approach
- The process approach

3.1.2.1 The inquiry/problem solving approach

In this approach children, inquire into a problem with a view to finding answers to problems or reasons why the problem exist.

- The use of Information and Communication Technology (ICT) in teaching
- Field trips
- Questioning technique

The current interest in science teaching emphasizes that this approach be used in teaching science.

The inquiry/problem solving approach may take the following forms

- Guided inquiry
- Free inquiry
- Modified free inquiry
- Inquiry role approach

In guided inquiry the teacher poses a problem and gives advice on how students would get to solve the problems. The free inquiry requires the students themselves to formulate the problems and devise strategies to solve them. The modified free inquiry approach allows the teacher to provide the problems, and the students are encouraged to tackle the problems on their own while the teacher act as a guide. The inquiry – Role Approach, according to Olarinoye (1989), involves the use of small groups with assignment of roles to every individual in the group.

3.1.2.2 The Process Approach

This approach involves the use of the science process skills in solving problems which students come across. As an innovation, this method allows students to perform mental processes such as observing communicating classifying, measuring, forming hypothesis analyzing which leads to discovery and generalization. We have studied the process skills more in unit 4 of this module.

3.1.2.3 The use of Information and Communication Technology (ICT) in teaching.

Information and Communication Technology according to Sambo (2002), are a part of the globalizing agent used in turning the world into a "global village". It refers to technologies used in collecting, storing, editing, and passing information in various forms. This includes the use of communication satellite, radio, television, telephones, video, tape recorders, compact discs, floppy disks and computers.
The computer can be used as:

i. An interactive teaching tool; performing and directing activities.
ii. A laboratory tool for performing a range of teaching and training activities including reasoning and analysis of data and
iii. ICT helps to generate, recall and compare information.
iv. The computer is used to carry out simulations and modeling in science practicals.

ICT prepares students to learn in a world increasingly rich in information.

SELF-ASSESSMENT EXERCISE

List the technologies used in collecting, storing, editing, and passing information.

3.1.2.4 Field Trip

Field trip provides opportunity for outdoor visits where learning experiences are acquired. As a science teacher, this could be used to reinforce and supplement whatever is being taught in the classroom. Students can be taken to museums, industries, automobile workshops, craft workshops, electrical workshops, and farms. Field trip reinforces classroom lessons, broadens the students' experiences by bridging the gap between science inside and outside the laboratory, advances cognitive abilities of the students and improves students attitude to learning science. Field trips also help students to develop process skills and their application in solving problems and finally, it promotes

socialization skills among students and between students and the people outside the school.

3.1.2.5 Questioning Techniques

It is very important the way you the science teacher control questions in your classroom. Questions can come up at anytime during the lesson to give directions, stimulate interest and be sure the students are being carried along. Questions should be of various levels and the teacher needs to acquire proper techniques to ask appropriate questions. There are two types of questions that can be used by the science teacher.

i. The Low – cognitive order questions: these are those that allow the students to recall
ii. Higher-order questions allow students to apply, analyse, synthesis and even questions what is being asked.

Each science lessons must then focus more on the highest level questions which behavioral objective is directed to draw, design, distinguish, relate, discuss, compare and justify.

3.1.3 Innovations in the Teaching and Learning Environment

The school learning environment is critical because it provides opportunities for cognitive and psychosocial development of the child. Studies have shown that students' outcomes such as subject matter achievement might be improved by creating classroom environment that are more conducive to learning (Pierce, 1994).

The learning environment is the laboratory. According to Ango (1990), laboratories provide students with experiences that are consistent with the goals of scientific literacy. What passed for a laboratory is the science corner or nature corner which was unplanned, unsystematic and deficient of work areas for individual pupils or groups.

The laboratory setting is an innovative strategy that creates opportunity for the development of skills in inquiry/problem solving and discovery in science learning.
Modern science teaching and learning emphasise active participation of the learners in the learning process through series of activities within the confines of the laboratory and outside of it using the immediate and remote environment.

3.1.4 Innovations in Instructional Resources Usage

In the early days, nature study lessons were taught with little or no instructional materials. Today, science teaching makes use of science laboratories with standard science equipment. Improvisation and substitute of instructional materials as you will learn in unit 8 of module 2, are encouraged where the original is absent or inadequate.
Video tape cameras, close circuit television, overhead projectors, simulation and computers are all innovations used in the teaching of integrated science.

Innovations in the area of text books include the publication of many integrated science textbooks by Nigerian authors, apart from textbooks, there are workbooks and teachers guide. Some of the textbooks are written in the local language of the community. There are also Open Educational Resources (OERs) that science teachers and students can assess on-line and use.

3.1.5 Innovations in Assessment of Learning Outcomes

A remarkable innovation that has taken place in assessment in integrated science is Continuous Assessment. Continuous Assessment has substituted the old traditional method where students' performance was measured by a single end of course National Certificate.

As an innovation the practices of Continuous Assessment came out of the provisions of the National Policy on Education (FRN 1981) which directs that "Progress along the educational cycle will be based on Continuous overall guidance – oriented assessment by teachers and head teachers". Continuous Assessment takes account of the entire learner's performance in a given period of time in the school. Continuous Assessment allows the full participation of the learner and enables the teacher to be flexible and innovative in selection of instructional content and methods in science teaching.

3.2 Implications of Innovations to Teaching and Learning of Integrated Science

According to Udo (1997) developing and implementing innovations are a complex activity which requires knowledge skills and considerable time and a variety of resources. A successful implementation of innovations in the teaching of science requires that:

i. The goal for which the innovation is directed should be set
ii. The learners need and characteristics should be known
iii. A plan of the innovation be carefully drawn

iv. The new approach should be tried over a period of time
v. The new approach is then introduced to the learners
vi. Feed back is obtained and possible modifications made
vii. Based on the modifications, the approach is evaluated and reviewed from time to time to see if it is operational

3.3 The Role of the Science Teacher in Implementing Innovations

The science teacher on his own part must:

i. be aware of innovations in science and what he is required to do
ii. be involved in the curriculum planning
iii. develop positive attitude towards innovations in integrated science teaching
iv. avail himself or herself with seminars and workshops for personal development and professional growth
v. carry out adequate diagnosis of the students interest and ability before introducing the innovation.

SELF-ASSESSMENT EXERCISE

What is the implication of innovation to the science teacher?

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you learnt that innovations in Integrated Science have been carried out in different areas. Such areas include curriculum structure, integrated science methodology, teaching and learning environment, instructional resources, and assessment and learning. You also learnt the implications of the innovations and the role of the science teacher in ensuring that the innovations are successful.

6.0 TUTOR-MARKED ASSIGNMENT

i. What are the implications of innovation to teaching and learning of Integrated Science
ii. What is the role of the science teacher in implementing innovations

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UNIT 7 THE BASIC TEACHING OF CREATIVITY IN INTEGRATED SCIENCE CLASSROOM

CONTENTS

1.0 INTRODUCTION

Creativity refers to the production of a new entity of ideas. Creativity can inspire students to learn new contents through a creative outlet. Integrated science teachers have a constant struggle between teaching content and incorporating creativity into daily instruction. In this unit, you are going to learn about creativity and how the teacher can incorporate creativity in his daily instruction to enhance teaching and learning in the integrated science classroom.

2.0 OBJECTIVES

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

- define creativity;
- explain what creative style is;

- mention the two broad creative style preference
- list and describe the techniques that can be used to aid creativity in integrated science classroom.

3.0 MAIN CONTENT

3.1 Creativity

Creativity has been defined in different ways by different people. Torrence (1995), explained that creativity is recognizing the gap in the problem or information, finding ideas or hypothesis, testing and developing these hypothesis and transmitting obtained. Muniford (2003) defined creativity as the tendency to generate ideas that may be useful in solving problems. The problem solving and creating hypotheses, designing experiments and creating novel innovation are all scientific process skills which require scientific creativity. Creativity is an important aspect of scientific skills. Therefore in order to be scientifically balanced, there is the need for science students to be creative.

3.2 Creative Style

Creative style is referred to as an approach to problem solving and other tasks that is creative (Best & Thomas 2007). Psychologists have recognized that there are different ways in which individuals interact with their environment and use information to solve problems. Stemberg (1998) and Starbuck (2006) explained that students need to participate in learning activities in order to understand the diverse nature of knowledge and to stimulate their general and critical thinking abilities. To teach science creatively, the integrated science teacher needs to recognize the fact that different students have different creative styles. In order to make integrated science students creative, there is need to know students creative styles and to develop interventions and strategies for individuals that are consistent with the unique characteristics of the individual.

Understanding students' creative styles can help students to appreciate why other students approach or solve problems differently from themselves. Individuals with different styles possess different creative strengths and weaknesses. Kirton (1994) identified two broad creative style preferences

SELF-ASSESSMENT EXERCISE

What is the importance of understanding student's creative style

The two broad creative style preference are (a) Adaptors (b) Innovators. Adaptors are individuals who prefer to define and approach problems within existing frameworks and structures. They are resourceful, efficient, organized, dependable and seem to supply stability, order and continuity (Selby, Treffinger, Isaksen &Power, 1993).

Innovators are individuals who prefer to solve problems by creating new framework. They are original, energetic, individualistic, spontaneous and insightful (Selby, Treffinger, Isaksen & Power, 1993).
Students develop their creative style through:

1. Measure of creative capacity
2. Belief in unconscious processes
3. Use of techniques
4. Use of other people
5. Final product orientation
6. Environmental control/behavioural self regulation
7. Superstition and use of the sense (Kumar, Kemler & Holman, 1997).

SELF-ASSESSMENT EXERCISE

What are the two broad creative style preferences?

3.3 Techniques that aid creativity in the integrated science classroom

3.3.1 Brainstorming

This is a lateral thinking process by which students are asked to develop ideas or thoughts. Brainstorming can help define issues, diagnose problems or possible solutions and resistance to proposed solution. Students should be encouraged to pick up an idea to create new ones.

3.3.2 Assumption Busting

An assumption is an unquestioned, assumed truth. Deliberately seeking out and addressing previously unquestioned assumptions stimulates creative thinking.

3.3.3 Role playing

Here, each student takes the role of a problem affected by an issue or event from the perspective of that person. This gives the students an opportunity to practice what they have learned. Once the role play is finished, spend some time on de-briefing.

3.3.4 Storyboarding

This can be compared to spreading students thoughts out on the wall as they work on project or solve problems. This method allows students to see the interconnections and how one idea leads to another.

3.3.5 DO IT

DO IT stands for Define problems be Open to many possible solutions, Identify the best solution, and then Transform it into effective action. This technique accelerates and strengthens students' natural creative problem solving ability in integrated science and stimulates good and diverse ideas.

3.3.6 Concept Mapping

Concept maps represent knowledge in graphic form. Concept maps can aid in generating ideas, designing complex structures or communicating complex ideas.

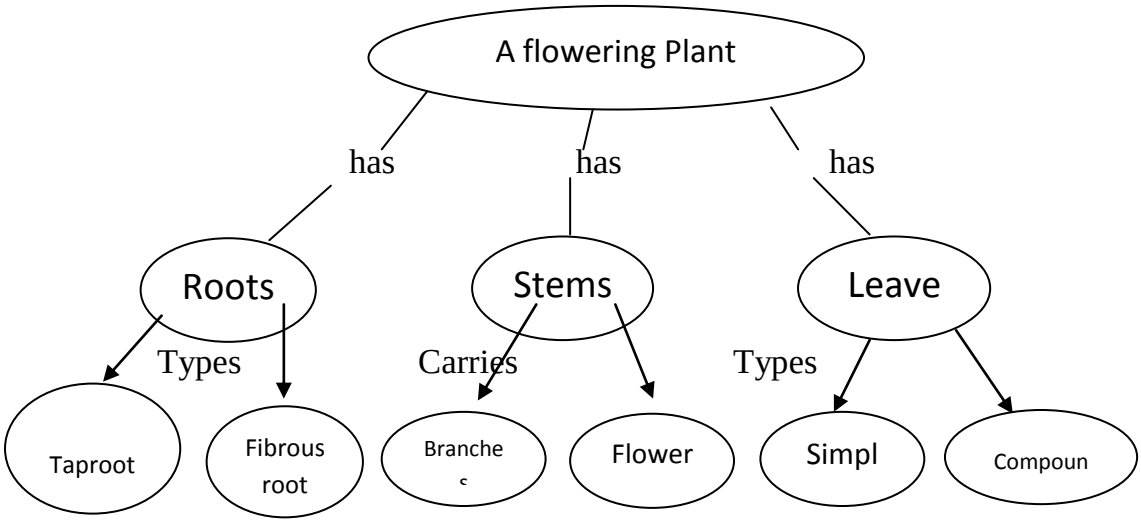


Fig 9.1: Examples of concept map in integrated science

3.3.7 Random Input

This is a lateral thinking tool that is useful in generating fresh ideas or new perspective on a problem, it fosters creative leaps and permits escape from restrictive thinking patterns. In this process, the student can select randomly from any integrated science topic. Example: Students thinking about reducing car pollution having so far considered all the conventional solutions e.g. catalytic conversion and clean fuels, can select randomly a book on plants. Students can then brainstorm and

generate new ideas such as planting trees on the side of the roads or passing exhaust gases through a soup of algae to reduce carbon-dioxide.

3.3.8 Skip writing

In this method, ideas can be gathered from large groups. Students are given slips of paper and asked to write down ideas which are discussed or evaluated in integrated science. This method collects a large number of ideas swiftly and creates a sense of ownership or participation.

Each student is given some slips of paper, question or problem is read to the group and students write down answers on their slips, one idea per slip. This will be collected, analysed and evaluated. The most useful ideas are identified and developed into practicable proposals.

3.3.9 Laddering

This is also called the "why method" it involves toggling between two abstractions to create ideas. Laddering techniques involve the creations, reviewing and modification of hierarchical knowledge. In a ladder containing abstract idea or concepts, the items lower down are subsets of the ones higher up. Students can ladder up or down to clarify concepts and their relationship.

3.3.10 Brain Sketching

This involves students making sketches to solve a specific problem and passing the sketches to fellow students. Here questions or problems are explained to the students. Each participant then privately makes one or more sketches and passes to the student next to him. Students develop or annotate the sketches passed to them or use them to inspire new sketches which are also passed in turn.

3.3.11 Reversal

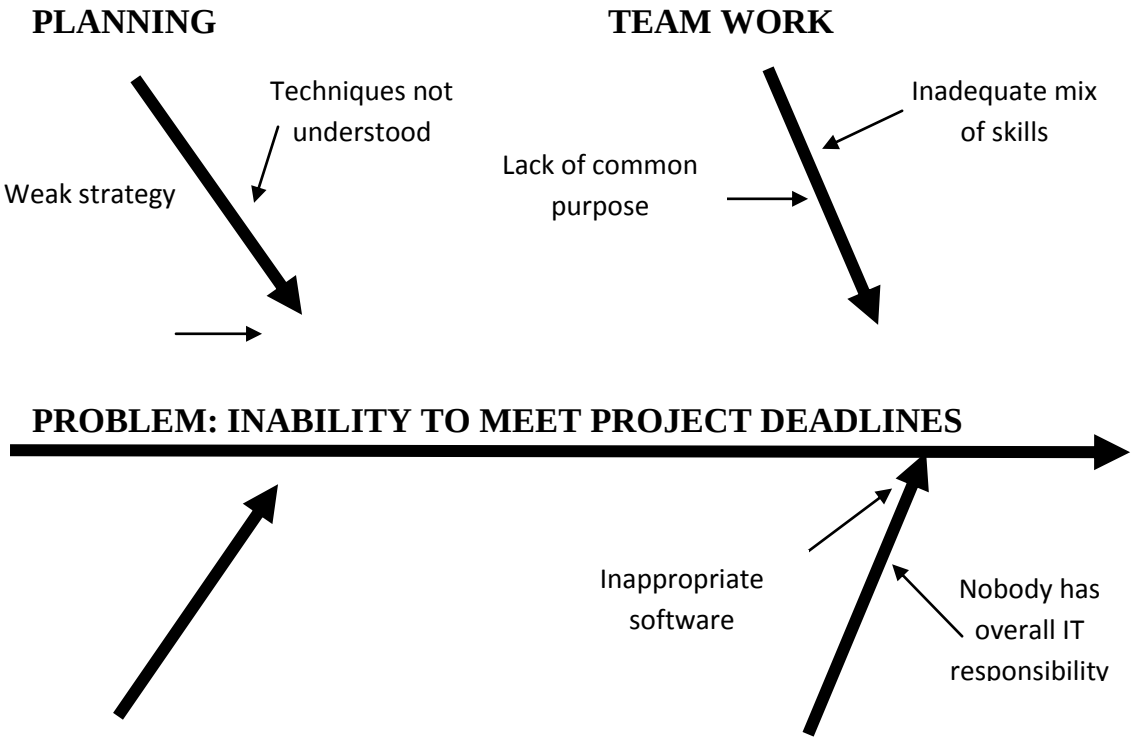
This method takes a given situation and turns it around. Any situation can be reversed" in several ways. Looking at a familiar problem this way can suggest new solutions or approaches.

3.3.12 Questioning Activity

Here, students create a list of questions in no known order. There are no criticisms or judgment of questions. This aids student to ask a myriad of questions, increase their productivity and motivation.

3.3.13 Fishbone

The fishbone technique uses a visual organizer to identify the possible causes of a problem. This technique discourages partial or premature solutions and demonstrates the relative importance of and interactions between different parts of problems in integrated science



Adapted from Mycoted wiki

Here the long arrow drawn horizontally is labelled with the title of the problem issue to be explained. This is the "backbone" of the fish. Spurs are drawn from this backbone at about 450, one for every likely cause of the problem that the group can think of, and label each. The group considers each spur/subspur taking the simplest first.

3.4 Importance of Creativity

Creativity improves the self esteem, motivation and achievement of learners. Students who are encouraged to think creatively become interested in discovering things for themselves; are open to new ideas and challenges; are also to solve problems and can work well with

others. Children are inherently creative, therefore the challenge of the integrated science teacher is to nourish and develop children's natural creativity and not to stifle it.

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you have learnt the definition of creativity as it relates to integrated science. You have also learnt about creative styles and the techniques that can be used to aid creativity in an integrated science classroom.

6.0 TUTOR-MARKED ASSIGNMENT

List and describe 3 techniques that can be used to aid creativity in an integrated science classroom.

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UNIT 8 CONSOLIDATION

1.0 INTRODUCTION

In units 1 to 7 we studied the design and structure of the Nigerian Integrated Science Curriculum as well as the review of the curriculum. We also looked at scientific attitude and its attributes which all scientists must have in order to carry out investigations. The science process skills were also discussed and methods of carrying out scientific investigations. Innovations in teaching integrated science were highlighted as well as the basic teaching of creativity in the integrated science classroom. In this unit, we are going to refresh our minds and consolidate on all we have gathered in the previous units.

2.0 OBJECTIVES

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

- Mention the importance of the spiral nature of the curriculum
- Mention why the curriculum review was imperative
- List the ten attributes of scientific attitude
- List the science process skills
- Mention at least three areas of science innovations
- Describe some innovations in Integrated Science
- Mention some techniques that aid creativity

3.0 MAIN CONTENT

3.1 Design and Structure of Integrated Science Curriculum

The integrated science curriculum is child centred and emphasis is laid on learning science as a process than as a body of knowledge. The general objectives of Integrated Science Curriculum is to enable pupils observe and explore the environment using their senses or their hands. The design of the curriculum is based on the spirality of themes. The spiral nature ensures that contents become gradually difficult as learners progress. There are problems and challenges in implementing the curriculum as discussed in unit 1. Solutions to these problems include seeking assistance of more experienced teachers, and you the teacher reading on your own and becoming familiar with the content areas.

SELF-ASSESSMENT EXERCISE

What is the importance of the Spiral nature of the curriculum?

3.2 Review of the Nigerian Integrated Science Curriculum

Valid curriculum content must be related to the philosophy and objective of education. Curriculum review became imperative as a result of the Federal government's decision to introduce the 9-years of Basic Education and the need to attain the Millennium Development Goals by 2015. The existing curriculum for Junior Secondary School was reviewed, re-aligned and restructured.

Integrated Science was replaced with Basic Science and Technology while Primary Science was replaced with Basic Science. In order to fulfill the goals of the curriculum reform, new themes were infused into the curriculum. These were Environmental Education, Drug Abuse Education, Population and Family Life Education, Sexually Transmitted Infections (STI) including HIV/AIDs.

SELF-ASSESSMENT EXERCISE

Why was the curriculum review imperative?

3.3 Scientific Attitudes

Scientific Attitudes are a composite of a number of mental habits or tendencies to react consistently in certain ways to a novel or problematic situation. Scientific attributes include belief, curiosity, objectivity, skepticism, open mindedness, creativity, risk taking, honesty, humility and responsibility. Students with positive feelings towards science,

achieve more and are also more likely to incorporate science into their daily lives when they appreciate its importance. To develop scientific attitudes in student, they should be provided with hands on experiences

SELF-ASSESSMENT EXERCISE

List the 10 attributes of scientific attitudes and explain each briefly

3.4 Science Process Skills

Science process skills are the skills and strategies both mental and physical that scientists use to carry out the processes of doing science. There are two types of process skills.

1. Basic process skills
2. Integrated process skills

The Basic process skills are observing, communicating, measuring, classifying, inferring and predicting.

Integrated process skills are controlling variables, defining operationally, formulating hypothesis, interpreting data, experimenting, and formulating models. The basic science process skills can be learned in a short period but the integrated science process skills takes a longer period. Science process skills are important because it makes learning experiences richer and more meaningful for students.

SELF-ASSESSMENT EXERCISE

What are Science Process Skills? Select an activity in science where you can use at least ¾ of the skills

3.5 Scientific Investigation

Scientific investigation is the way in which scientists and researchers use a systematic approach to answer questions about the world around us. Patterns of scientific investigations are deductive science reasoning and inductive science reasoning. The steps for scientific investigation follow the scientific method they generally include observation, formulating a question and hypothesis, setting up an experiment, analysing the data collected and drawing conclusions. Scientific findings can be communicated to other scientists through scientific journals using standard scientific paper format.

SELF-ASSESSMENT EXERCISE

List the steps involved in scientific investigation. How is that different from science process skill?

3.6 Innovations in Teaching Integrated Science

Innovations refer to changes or new ways of doing things. In unit 6, you learnt that innovations in Integrated Science embrace such areas as innovations in curriculum structure, innovations in methodology, innovation in the teaching and learning environment, innovations in instructional material usage, and innovations in the assessment of learning outcomes. There is considerable overlap in the content of these areas because they are integral parts of the whole teaching and learning processes in science. The implication is that you as the science teacher must be aware of the innovations in science and what you are required to do.

SELF-ASSESSMENT EXERCISE

What are the innovations in teaching integrated science?

3.7 The Basic Teaching of Creativity in Integrated Science Classroom

Creativity refers to the production of a new entity of ideas. Creativity inspires students to learn new contents through a creative outlet. Creative style is an approach to problem solving and other tasks.

The two broad style preferences are adapters and innovators. You should refer to unit 7 to refresh your memory. Some techniques that aid creativity include: Brainstorming, Assumption busting, role playing, story boarding, DO IT, concept mapping, Random Input, skip writing, laddering, Brain sketching, Reversal, questioning activity, and fishbone.

Creativity in science teaching is important because it improves the self esteem, motivation and achievement of learners. The role of the science teacher is to nourish and develop children's natural creativity.

SELF-ASSESSMENT EXERCISE

Mention the techniques that aid creativity and explain how

4.0 CONCLUSION

5.0 SUMMARY

In this unit, we summarized units 1 to 7. Go back to these units and study them again. Reflect on the different aspects and internalize them.

6.0 TUTOR-MARKED ASSIGNMENT

i. Enumerate the science process skills
ii. List the steps involved in scientific investigation
iii. What is the implication of innovations to the science teachers

7.0 REFERENCES/FURTHER READING

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MODULE 2 DIFFICULT TOPICS/UNITS IN NIGERIAN INTEGRATED SCIENCE CURRICULUM 11

UNIT 1 PREPARATION FOR TEACHING INTEGRATED SCIENCE LESSONS

CONTENTS

1.0 INTRODUCTION

In integrated science lessons, instruction is used to impart information and knowledge to a learner. Planning instruction can be seen as setting

the stage for proper teaching activities. In this unit, you are going to learn how a teacher can prepare and teach integrated science using the syllabus and scheme of work You will also look at sample lesson plans and notes.

2.0 OBJECTIVES

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

- define the concept instructions.
- relate instruction to curriculum;
- describe unit of instruction;
- describe syllabus and scheme of work
- list the components of a lesson plan
- write sample lesson plans

3.0 MAIN CONTENT

3.1 Concept of Instruction

Instruction is defined as the processes of imparting information and knowledge to a learner. Instruction is a teacher initiated activity, designed to facilitate receptivity by the learners. Instruction can be organized in three phases: introduction, development and culmination.

3.1.1 Introduction Activity

Introduction activities are used to introduce learners to a particular topic. It is meant to arouse the learners' interest. Introduction can be based on previous knowledge of the students. In introducing a lesson the teacher should direct the students' attention to the objectives, enhance retention, stimulate recall and promote transfer to knowledge.

3.1.2 Developmental Activity

This is the main frame of the unit. The unit to be taught is presented to the learners through any appropriate teaching method.

3.1.3 Culminating Activity

This is the conclusion of the instructional phases. They are intended to synthesise and end the lesson and demonstrate the accomplishment of objectives. Activities here can take the form of questions and answers between the teacher and the learners.

4.2 Structure of Curriculum and Instruction

Many curriculum specialists still disagree on whether curriculum and instruction should be conceived as a unified whole or each is to be treated as completely different entities. Tanner and Tanner (1975) opined that curriculum and instruction should not be deliberately separated. The word instruction when discussed under education is known to be a special aspect of teaching. Curriculum is a written document of experience (Cognitive, affective and psychomotor) which are provided to learners, while instruction is the process whereby the environment of an individual is deliberately manipulated to enable him or her to learn to engage in specified behavior under specified conditions or as responses to specified situations

3.2.1 Syllabus

The syllabus is derived from the curriculum. While the curriculum has global aim of developing the individual, the syllabus is more or less an examination conscious document assembled to give directives to teachers especially on instructional aspects. The syllabus in addition includes detailed notes on the depth of materials to be taught on each topic.

Broadly speaking, the syllabus is that aspect of curriculum that lists subject to be taught in a given course or programme. The outline of the syllabus is meant to guide the teacher on the extent of work involved in a particular class. Sometimes, the syllabus often gives detailed instructions on what is to be taught in each term of each year of a course, what books are to be used and even what method, are appropriate (Farrant, 1980).

3.2.2 Scheme of Work

The scheme of work is directly derived from the syllabus. It is the subdivision of the entire school syllabus into specific portions. It is an indication of the amount of a particular learning activity that can be covered within a specified time. The syllabus is broken down into teachable topics e.g for a school term of 13 weeks. The objectives of teaching each weekly topic are contained and in addition, the scheme of work indicates teachers' and pupils activities as well as reference books which can be consulted for information on particular topic.

A scheme of work can be defined as a plan or outline of academic work in a sequential concordance. The scheme of work must be tailored to suit the ability, interest and rate of learning of pupils. To draw a good

scheme of work, the following elements should be taken into consideration

1. The syllabus
2. The pupils (age, average ability, quality of group motivation)
3. The school calendar (how long the term is and the number of periods for each subject per week)
4. Logicality of topics or sub-topics

The things to include in a scheme of work are:

1. Particulars of the learners
2. Previous knowledge and experience of the class in respect of the subject matter
3. The number and duration of the lessons
4. The aim of the scheme of work and outline of the subject-matter and the content with the objectives of each lesson.
5. The way the students learn, the method of teaching, and learning to be employed
6. Source of information e.g. books,
7. Equipment to be used.

SELF-ASSESSMENT EXERCISE

Define

1) Syllabus
2) Scheme of work
3) Mention the elements to be considered when drawing a scheme of work

3.2.3 The lesson plan and lesson note

Lesson plans and lesson notes mean different things to different people. A school of thought, according to Duyilemi (1997), conceives the daily guides to instruction as lesson plan. To that school, a lesson note is said to be complete when all mental and physical preparations for a day's topic are already put on paper. The lesson plan and lesson note are nowadays regarded as meaning one and the same thing. Current debates seem to favour the need to remove the artificial boundary which for many years existed between both terms. The lesson plan and note are the final state in curriculum implementation. A lesson plan is a well thought out, orderly and sequential arrangement of the lesson on paper. It is the guideline by which the teacher teaches his lesson. When a lesson plan is transcribed into a note book, it becomes a lesson note.

3.2.3.1 Components of a lesson plan

The basic components of a lesson plan include the following

1. The subject
2. Date
3. Time/Duration
4. Class
5. Period
6. Average age of the learners
7. Topic
8. Behavioural objectives
9. Entry behavior/previous knowledge
10. Instructional material/resources
11. Introduction/set induction
12. Instructional techniques or skills
13. Instructional procedure
14. Evaluation

3.2.3.2 Characteristics of poor lesson

A poor lesson is characterized by one of the following:

1. Lack of logical presentation of material
2. The omission of important facts, due to lack of adequate knowledge of subject matter
3. Inaccurate facts taught or accepted as correct
4. Poor timing of the lesson.
5. Lack of ability to motivate the class, resulting in boredom and restlessness in the class
6. Lack of interesting detail of illustrative aids
7. Excessive corrections when the assignments or written work of learners are being marked.

3.2.3.3 Sample lesson plan

Subject: Integrated Science
Date: 23rd August, 2014
Time/Duration: 1 hour 10 minutes
Class: Primary 6
Period: Double Period (5th & 6th periods)
Average age: 11 – 12 years
Topic: Energy
Subtopic: Sources of Energy

Behavioural Objectives: by the end of the lesson, the pupils should be able to:

1. explain the concept of energy
2. identify the sources of energy

3. list the forms of energy
4. explain how energy is converted from one form to another

Instructional Resources
Battery, wire, bulb, drum, matches, water, food, kerosene.

Entery behavior: Identification of prior idea about the topic or related topics.

1. What did you eat this morning? If you run to school what will happen? What happens when you lift heavy load? What helps vehicles to move?

Instructional Techniques or skills
Questioning, demonstration, carrying out activities

Instructional Procedure

Step 1: Content Development
Concept and Sources of Energy

Teachers Activity**:** Group pupils into three
First group runs round the field
Second group jumps like a frog
Third group matches round the field. Let them understand that any work they perform, they make use of energy, so energy is the ability to do work

Pupils Activities: they perform the activities assigned them

Step II: Sources of Energy
Teachers' Activities: questions Group the pupils and assign each group to answer.
Group 1: they mention different kinds of food they eat
Group 2: They identify things that give light
Group 3: They discover what makes leaves and branches on a tree to move
Group 4: They mention what we buy in filling stations

Explain that all of their answers are sources of energy e.g. food, sunlight, wind water, petroleum etc.

Step III: Discussion
Teachers Activities: Direct each group to discuss how they get energy
Pupil's Activities: They respond to the activities and discussions.

Step IV:

Teachers Activities: Ask them questions

(a) What do you require to do work?
(b) What do you take in your home that gives you energy?
(c) What helps your lamp to light
(d) Mention other sources of energy

Step V: Evaluation

Teachers activities**:** Evaluate with questions

(a) Explain the concept of Energy
(b) What are the sources of energy?

Public Activities: They respond to the questions

Step VI: Forms and Conversion of Energy

Teachers Activities: Group and give them what to produce before the class

Group 1: Produce drum
Group 2: Produce Circuit
Group 3: Bring in firewood, metal and matches

Group 1: Direct them to beat the drum, what did you observe? Sound
Group 2: Switch your circuit/torch on; what happens? Light
Group 3: Light your firewood and put metal inside it.

Explain various forms of energy which include sound, light, chemical, heat, mechanical etc.

Step VII: Conversion of Energy

Teachers Activities: Explain with examples that these forms of energy can be converted from one form to another.

Group 1: Beat your drum

Explain that when a drum beats, it produces sound, other objects like flutes, generators; grinding machines etc also do so. Here, mechanical energy is converted to sound.

Group 2: When you light your wood, it gives light. Here heat energy gives/converts to light. When a lighter is left under the metal, it will also heat and convert to light

Pupils Activities**:** They respond to the activities

Step VIII: Discussion

Teachers Activities**:** Ask the pupils to discuss the topic they have learnt
Pupils Activities**:** They respond to discussion

Step IX:
Teachers Activities**:** Hello Children

1. Mention objects that give light to your homes
2. How does electrical energy convert to light?
3. Enumerate objects that produce sound in your locality
4. Explain how mechanical energy in your home converts to some energy
5. How does your mother convert heat energy to light?

Pupils Activities: They respond to the question above

Step X: Evaluation
Teachers Activities: Evaluate with questions

1. Enumerate the forms of energy
2. How can one form of energy be converted to another?

Pupils Activities: They respond to the questions

Source: An NTI–TESSA integrated Manual for the retraining of primary school Teachers:
Basic Science and Technology, September 2011.

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you learnt that instruction is the process of importing information and knowledge to a learner whereas curriculum is a written document of experience which are provided to learners, instruction on the other hand, is the process whereby the environment of an individual is deliberately manipulated to enable him or her learn to engage in specified behavior under specified conditions. You also learnt that the syllabus is derived from the curriculum and the scheme of work equally derived from the syllabus. The lesson plan when transcribed into a note book is known as the lesson note. Sample lesson plan and notes were also described.

6.0 TUTOR-MARKED ASSIGNMENT

i. Write a comprehensive lesson note on any topic in a subject of your choice for JSS II and a 40 minute period
ii. What are the characteristics of a poor lesson

7.0 REFERENCES AND FURTHER READING

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UNIT 2 EFFECTIVE COMMUNICATION AND INTERACTION IN INTEGRATED SCIENCE CLASSROOM

CONTENTS

1.0 INTRODUCTION

There are different methods used in teaching integrated science. Whichever method you choose to use, communication is applied. There are different ways you can communicate. Language however encloses the several ways of communication. When the language in a text book and that of teaching is different from the learner's mother tongue or first language, there are bound to be problems. In integrated science, there are scientific names and terms which are often used. The purpose of this unit is to examine the problems and influence of language in the teaching of science and how to avoid these problems.

2.0 OBJECTIVES

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

- describe the importance of language to integrated science
- explain the influence of language on scientific terms
- name three advantages of encouraging learners to talk
- explain two problems associated with the use of language in science teaching
- identify some solutions to language problems in science teaching

3.0 MAIN CONTENT

3.1 What is Communication?

Communication is the imparting or exchanging of information by speaking, writing or using some other medium. Communication can also be seen as the act of transferring information through verbal messages, the written word or non-verbal signals.

The main purpose of language is for communication. Communication in class can be verbal that is through the use of English Language or language of wider usage in the community in which the school is located. It could also be non-verbal through the use of sign or body language.

While teaching science, you should use words, gestures, symbols, or graphics to describe an object, action or event. Confusion may set in when the words used have different meaning from what students already know. Some common English words have uncommon meanings in science e.g power, heat, energy. If you have any problem of finding appropriate words in English to explain certain concepts, to students, you can use the local language where possible.

3.2 Importance of Language in Science Learning

Language is always a problem in the teaching and learning of science. This is especially so when the language in the textbook is a second language different from the mother tongue or first language of the students. Again, there may be non-availability of words that are parallel to or direct interpretations of the terms used in science, to identify equipment or describe ideas and concepts.

Teachers, very often, resort to the use of a language which they feel is common in the locality and which may be second or even a third language for most of the children.
You as the teacher of science should study the environment in which the school is located and the level of development of your pupils. You should use the mother tongue or the local language to communicate with your pupils especially at the lower basic level. They will understand science better if you use their language.

The Nigerian Educational Research and Development Centre (NERDC) has developed Dictionaries of many Nigerian languages which you can consult for assistance on scientific and technical terms. Students should be allowed to talk and express themselves in the science class. Give

them time to use the words which you have introduced especially when they are carrying out experiments or observing things. Children strengthen their understanding when they talk about what they do. To understand science involves the ability of the child to freely express himself, ask questions to clarify some issues and reorganize his thoughts.

In writing in science, the passive voice is used especially when recording experiments. For example the beaker was filled with water, the test tube was heated etc. This passive way of writing is the best for accurate scientific writing.

SELF-ASSESSMENT EXERCISE

1. In which language are you expected to teach in your primary school?
2. Do your pupils speak the same language?
3. What language do the teachers speak?

3.3 Influence of language in science learning

Science as a discipline has its own set of words, phrases and terms which have different meanings from the literal or ordinary usage. Therefore any language used for teaching science must copy these words and phrases and terms without alteration. The English language used in science assimilates scientific words from other sources into its vocabulary. Some of these words are imported from Latin language and have become a part of the English language without any change. e.g. meniscus, nucleus saliva, cerebellum.

3.4 Problems of Language Influence in the Learning of Science

3.4.1 Mother Tongue Factor

Students can only write well in the language they speak well. Students who use their mother tongue often in their everyday activities often become handicapped when it comes to writing or speaking or understanding a second language. They are incapable of recognizing the linkage between the words in the sentences and so are unable to think logically in subjects taught or written in the second language (English).

3.4.2 Teacher Factor

The teacher may have difficulties in expressing himself or herself for a student to understand especially if the teacher cannot express himself in

English Language. Science which has a lot of abstract scientific words poses more problems for the teacher.

3.4.3 Use of gestures

There are limitations when gestures (facial expressions and body movements) are used by a teacher to make the student gain additional information about a given topic.

SELF-ASSESSMENT EXERCISE

How can teacher factor pose a problem in the teaching of science?

3.5 Ways in which language problems can be minimized in learning science

1. You, the teacher can drill the students in science vocabulary
2. You should use more teaching aids in place of gestures to avoid distracting the students.
3. You should list the specialist scientific words in a topic whenever you are preparing the lesson

4.0 CONCLUSION

5.0 SUMMARY

In this unit, you learnt that:

- Communication is the act of transferring information through verbal messages, the written word or non-verbal signals. You learnt the importance of language and the influence of language on scientific terms.
- you also learnt the two problems associated in the use of language in science teaching and solutions to problems in science teaching

6.0 TUTOR-MARKED ASSIGNMENT

How does mother tongue or local language pose a problem for students who learn science in a second or third language?

7.0 REFERENCES/FURTHER READING

Born, G. et al (1985). *Communicating Physics Germany:* University of Duisberg.

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UNIT 3 THE USE OF TEAM TEACHING AND MICRO-TEACHING IN INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Integrated Science education is undergoing dynamic revolution not only in curriculum but also in teaching methods and techniques. Evidence from learning theories now calls for new methods of instruction and new orientation for teachers. Hence, there is the need to adequately prepare integrated science teachers along such changes. Two instructional approaches that are receiving greater attention now in professional teacher training, are team teaching and micro teaching. In this unit therefore, we will examine these two concepts of teaching as they relate to integrated science

2.0 OBJECTIVES

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

- explain the concept of team teaching and Micro teaching;
- discuss the strength of team and micro teaching;
- identify problems you may encounter in using team teaching
- mention necessary guidelines in using micro teaching

3.0 MAIN CONTENT

3.1 Team Teaching

Team teaching is a teaching strategy involving a group of teachers who are jointly responsible for the planning and teaching of a course, with each member of the team having a specific role to perform. The group may be two or as many as five or six depending on the nature and objective of the course, class size, available facilities, books and time. The composition of a team should include subject specialists, and supporting staff. The role of each member of the team is determined by individual competence. For example, some teachers are better in lesson presentation, some more effective in laboratory situation while others may be good in improvisation and preparation of teaching aids, or in test construction and administration

SELF-ASSESSMENT EXERCISE

Mention one reason why team teaching can be used in integrated science teaching

3.1.1 Forms of Team Teaching

Team teaching can take the following forms
1. Large group instruction
2. Small group instruction

1. Large group instruction:

In this form, two classes may be combined. Two or more teachers could participate, each taking various aspects of the lesson. In this arrangement, one of the teachers may handle the whole class while the other teacher serves as support staff. The support staff may help in taking smaller group within the large group in discussions, written work or practical work based on the lesson.

2. Small group instruction

In this form, the class is divided into smaller groups for instructional purpose, each under a teacher. Each teacher guides his/her group in their activities. The team members would have jointly planned what to do previously. This type of set up enables the learner to participate more in the activity of the class and receive greater individual attention.

In each form, close cooperation between members of the team is very important and essential.

3.1.2 Guides for Running Team Teaching

1. Proper planning is essential and is the key for successful execution of team teaching
2. Team members should sit together and schedule the time, period, content and materials to use.
3. They should also decide on the composition of the team and responsibilities
4. There should also be a team leader who coordinates the activities of the team.
5. The team must ensure that the method will give certain advantage to the learners over the usual conventional set up, realize the objectives of the lesson and that available facilities are adequate.

SELF-ASSESSMENT EXERCISE

List 3 guidelines that will enable a group undertake effective team teaching

3.1.3 Advantages of Team Teaching

1. The composition of team is made up of teachers with varied experience and professional competence and their coming together to share, helps to improve and enhance the professional growth of each member
2. Team teaching helps to ensure that the content of a lesson which may be much for one teacher to handle is taught effectively by two or more teachers
3. The workload of team members are reduced and that gives each teacher more time to plan other lessons adequately.
4. It can promote better individual attention given to students and therefore tends to make students work better.
5. Team teaching makes teaching and learning more effective

SELF-ASSESSMENT EXERCISE

What are the advantages of team teaching over the conventional one teacher one class instructional set up?

3.2 Micro Teaching

Micro – teaching is a training strategy used in teacher training colleges to promote desirable teaching skills of prospective teachers like you. Micro teaching is a scaled down short session teaching encounter which

is used for teacher training. It is a model of the normal teaching practice but with slightly different objective.

Its objective is to enable the student teachers acquire appropriate teaching skills before going on teaching practice or before assuming full teaching responsibility.

3.2.1 Features of micro-teaching

These include:
1. The student/pupils (usually between five to ten in number)
2. A brief lesson (usually five to twenty minutes)

3.2.2 Guidelines for Micro-Teaching

1. Identify your students
2. Identify the lesson topic
3. Write down the lesson objectives
4. Identify the necessary teaching materials/equipment
5. Identify the learning activities
6. Read books and necessary materials to ensure mastery of the lesson content
7. Identify teaching methods and teaching styles to be employed
8. Set lesson duration
9. Write the lesson plan

During the presentation, you should
- Arrange your class properly to allow proper visibility and audibility
- Introduce the lesson by stimulating the learners' interest, relating the topic to the pupils experiences and stating the objectives of the lesson clearly
- Show confidence in presenting the lesson and handling the teaching aids
- Ensure that the presentation is interesting and appropriate to the age of identified students
- Make your teaching activity oriented by engaging students in meaningful activities
- Build in assessment procedures in your teaching
- Ensure time for summary and conclusion
- Wisely allocate your time

After the presentation you should ensure you make self assessment of your teaching by asking questions like

- To what extent have I achieved the lesson objectives?
- To what extent has the teaching changed my students' behavior?
- Have I used appropriate method?

You should also be prepared to
- Listen to assessment given by your supervisor
- Provide students with paper to give their assessment of the lesson
- Combine information from the assessment made to improve your teaching
- If necessary, rework and represent the lesson

3.2.3 Advantages of Micro-Teaching

1. It provides opportunity for student teachers to match learned theories and methods of teaching with practice
2. The student-teacher is assessed by the supervisor, the pupils and himself for an immediate feedback of his performance
3. It enables the student-teacher to identify his strengths and weaknesses and therefore make effort towards minimizing his weaknesses and improving his identified skills or strengths.
4. Immediate guidance can be given in the area of demonstrated deficiency and opportunity could be given to repeat the exercise.
5. It provides safe opportunity to practice different teaching skills and styles unlike during teaching practice.
6. Micro-teaching when compared with teaching practice, is cost effective in terms of money, time and other resources.

3.2.4 Disadvantages of Micro-Teaching

1. It cannot be a substitute for real teaching situation.
2. It does not deal with large class and its attendant problem of discipline and control, thus the teaching situation is more artificial than real.

SELF-ASSESSMENT EXERCISE

State 3 advantages of micro-teaching towards professional growth of a student teacher.

4.0 CONCLUSION

5.0 SUMMARY

You have learnt that:

- Team teaching is any form of teaching in which two or more teachers purposefully share responsibilities for the planning, presentation and evaluation of lessons prepared for the same group of students
- Team teaching can either take place in large class settings or in small group set up
- Success of team teaching depends on careful planning and cooperation on the part of every member of the group
- Team teaching has its advantages which culminate in the improvement of teaching and learning
- Micro-teaching is a scale down, short session teaching encounter which is used for teacher training
- Micro teaching provides student teachers the opportunity to acquire professional skills needed for their teaching assignment after graduation.

6.0 TUTOR-MARKED ASSIGNMENT

i. Explain the meaning of the term team teaching and micro teaching
ii. List 3 merits each of team teaching and micro teaching

7.0 REFERENCES/FURTHER READING

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UNIT 4 EFFECTIVE MANAGEMENT OF LARGE CLASSES IN INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Large classes and overcrowding in integrated science classrooms are some of the challenges being faced by integrated science teachers in the school. Although the recommended number of students per class is between 30-40, (FRN, 2004), in large classes they could be as many as 100 or even 200 per class. The classroom may also lack adequate seats and instructional materials. Besides, the students may have varying abilities and interests. In this unit, we are going to look at ways in which an integrated science teacher can overcome this challenge and increase the learning abilities of the students.

2.0 OBJECTIVES

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

- identify appropriate teaching methods for managing large classes effectively;
- state the teacher competences required in teaching large classes;
- determine activities that could be used in the science classroom for better skills acquisition;
- identify ways of improvising instructional materials

3.0 MAIN CONTENT

3.1 Teaching Methods

The teaching methods or strategies that are used in teaching integrated science must encourage lots of child-centred activities that provide first hand experiences that will allow the students to develop some process, manipulative and social skills. The strategies include class activities demonstration method, project method, ICT applications, Team Teaching. How practicable are these strategies in large classes where the teacher is expected to ensure that every child participates, whether in group or as individual?

SELF-ASSESSMENT EXERCISE

List some strategies that can be effective in teaching integrated science in large classes

3.1.1 Use of Class Activities

Class activities can be used to effectively manage large classes.
Students can be grouped into groups of four, eight or ten to carry out specific activities.

Ensure that in each group, there is equal number of males and females and that each group has a leader. Move around to assist where necessary in the activities. Incorporate specific questions or exercise that requires student participation in each group. The question or exercise can take several forms.

a. Think -pair -share

The teacher poses a questions or problem, to the class, after giving time to the students to consider that response (think), the students are asked to partner with another student to discuss their response (pair). Pair of students can then be asked to report their conclusions and reasoning's to the larger group (share) which can be used as a starting point to promote discussion in the class as a whole (Angelo & Cross, 1993).

b. Minute Paper

This is a type of classroom assessment that could be used to promote student engagement. At the end of the class segment, students are asked to spend one to three minutes writing the main point. These papers can serve as a tool to promote meta cognition and also could be used by the teacher for formative assessment.

3.1.2 Demonstration Method

This involves carrying out integrated science activities to illustrate science and technology concepts or ideas.
This method is especially useful for handling large classes.
Demonstration can be carried out by

- the teacher alone or
- the teacher with a student
- in carrying out demonstration the teacher should as much as possible:
    i. explain clearly the purpose of the demonstration
    ii. ensure that all students see every part of the demonstration
    iii. involve the students as much as possible
    iv. use simple and readily available apparatus and materials for demonstration

3.1.3 Project Method

In project method, the central theme, problem, or idea is selected by the teacher or the students or by both the teacher and students. The task is further divided into sub themes, ideas or problems. The students are encouraged to investigate, collect specimens or materials, analyze and construct things on their own.

The teacher only acts as a facilitator in the students learning. The students can work individually or in groups. At the end of the investigation, the reports on the project are collected and discussed with the whole class.

SELF-ASSESSMENT EXERCISE

Give examples of projects in integrated science that can be given to students

3.1.4 Applications of Information and Communication Technology (ICT)

One can use different ICT applications to teach large classes. The existence of ICTs does not transform teacher practices however ICT can enable teachers to transform their teacher practices given a set of enabling conditions. ICTs are seen as important tools to enable and support the move from traditional “teacher Centric” teaching styles to “learner centric” methods.

Computers and the internet can be used to produce educational games, drills and practices, simulations, tutorials, use of encyclopedia,

interactive maps and atlases and electronic journals. These can be very useful in the management of large classes in integrated science.

3.1.5 Team Teaching

Team teaching is a strategy used at many grade levels in many schools. This strategy can be effectively used in managing large classes. Teachers can come together to form teams. A good team includes different styles, such as an authoritarian, a caregiver, and a cheerleader Students will respond differently to these teachers and all their needs will be met. Every child needs someone in his or corner. Sometimes their teachers are all they have. Working together to create curriculum and to teach effectively will go a long way in enhancing learning in a large class. The working of the team ensures that each student gets the needed attention at all times.

3.2 Teacher Competences

1. The teacher must be able to learn and use students' names. This helps to ensure a broad based participation
2. The teacher must establish rapport with the students
3. The teacher must be patient and affirmative with the students in and outside the classroom
4. Develop strategies to encourage students to use office hours to meet him/her
5. The teacher must try and promote an environment of trust and mutual respect to prevent the fear of peer judgment.

3.3 Ways of Improving Instructional resources

The majority of instructional resources required for the teaching of integrated science are available. In the school or home environment, these include basic tools such as hammer, spinner, screwdrivers, nails, planks, plywood copper wires, dry cell batteries, simple machines, beakers, test tubes, funnel, measuring cylinders, tape rules, cardboard paper, gum, scissors, blocks of various sizes, shapes and colours, plastic basins rulers. Adequate use of these materials needs to be made by the teacher.

4.0 CONCLUSION

5.0 SUMMARY

In this unit you have learnt that:

- Most classrooms especially in rural areas in Nigeria are large and overcrowded with inadequate number of teachers.

- Appropriate teaching methods for large classes include
- Class activities, demonstration, projects, ICT applications and team teaching.
- science teachers require competences to handle large classes in integrated science and
- improvised instructional materials are necessary in large classes

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Mention any two strategies for managing large classes in integrated science
ii. Explain the term think-pair-share
iii. Mention any materials you can source for locally

7.0 REFERENCES/FURTHER READING

Angelo, T.A and Cross KP (1993) *Classroom Assessment Techniques: A handbook for College Teachers*, 2nd Edition San Francisco: Jossey – Bass

National Teachers Institute (2008) "handling Large Classes", *In Basic Science and Technology" In An NTI Tessa Integrated Manual for the Retraining of Primary School Teachers: Basic Science and Technology* Kaduna: NTI Press

UNIT 5 TEACHING INTEGRATED SCIENCE IN MULTIGRADE CLASSES

CONTENTS

1.0 INTRODUCTION

Multigrade classes are classes where you may have children of different ages and different grade levels. Some rural schools in Nigeria have multigrade classes due to economic constraints or shortage of teachers. In some schools also, even the single grade classes are overcrowded and have characteristics of multigrade classes. Most of our teachers have been trained to teach in single grade classrooms, therefore when placed in a multigrade setting, they find it difficult to cope. In this unit you will learn how to organize multigrades classes for effective instructional activities.

2.0 OBJECTIVES

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

- explain the meaning and nature of multigrade class;
- plan your lessons in a typical multigrade class

- identify instructional approaches for successful teaching of multigrade classes
- organize suitable physical environment for teaching and learning in multigrade classes;
- state difficulties encountered by multigrade class teachers;
- state advantages of teaching in multigrade classes

3.0 MAIN CONTENT

3.1 The Multigrade Class

The multigrade class structure is known by different names.
The multigrade class can be defined as a class where pupils or students of two or more adjacent grade levels are taught in one classroom by one teacher for most, if not all, of the day.
These multigrade classes are embedded within the traditional grade system. Students retain their grade level labels and are promoted through the school with their grade level cohorts.

SELF-ASSESSMENT EXERCISE

what are the various names given to multigrade classes in different countries?

3.2 Planning in a multigrade classroom

The teacher needs a strategy to help with planning of programmes to be used in teaching in a multigrade classroom. One way is to create programmes for the class, with different objectives and outcomes for the different groups in the class.
Objectives which need to be covered in the syllabus are included and common topics are identified across the grades.
A continuum or progression of challenges in our teaching will meet the needs of students in the class.

SELF-ASSESSMENT EXERCISE

Describe how you as the teacher in a multigrade classroom can plan and organize learning experience in your class.

It is up to the teacher to plan and organize learning experience best suited to the students in the class. For each unit of work or weekly plan, you can give the whole class the same topic or theme but the activities given to the different grade levels will differ depending on what you want them to learn and the students' level of development.

Table 6:1 Below shows a typical lesson plan in a multigrade integrated science classroom

Table 6:1

Learning outcomes	By the end of this lesson, you have collected and displayed real items in a logical way in your classroom to support your students learning about grouping living things Use model building as a way of recording what your student know about different plants and animals.	Materials and notes
Activity 1: collecting evidence of life around us (whole class)	Tell your students that they will be developing a display to show non-living and living things around them. Explain that it will not be right to display real plants and animals. They should not damage or kill any living thing instead like detectives they should hunt for clues and evidence of any living thing e.g feathers, dropping, leaves, and seeds. Choose six things for the display three living and three non-livings and display them on another table. Gather your student and the table and ask them which of the six things are living and how they know this. By careful questioning and discussion you should be able to draw up a list of the seven characteristics of living things. You might want to include this list of characteristics as part of the display. Finally, you could ask students to categorise things into further sub-groups: animals, plants and so an. Ask them to think about what defines each group and where each item is located in the display	Give pupils several days to bring in things for the display Seven characteristics of living things: • Nutrition • Reproduction • Growth • Respiration • Sensitivity • Movement • Excretion
Activity 2: building models of plants (Small groups according to grade or ability level)	Scientists group things by similarities and differences in the basic patterns of their structure and form. One way to find what your pupils observe about patterns in plants is by asking them to make models. Organize the scrap materials so that each group has a selection to use. Write the following instructions on the chalkboard. • Talk about what a plant look like • Then make models of plants from your materials. If higher grades or moveable group finish first, work with them to develop a lexicon (a small dictionary) to show which words the students knew, to describe the part of plants that they were familiar with (you might find it useful to put these words round your classroom and encourage the students to use them when talking about their models).	Before this activity, ask your students to bring in scrap materials and collect some. Your scrap materials might include tin, Cardboard, string, straws, plastic bottles fabric, paper, netting wire.

Adapted from TESSA Science Module 1: Looking at life, section 1: Classifying living things
http://www.tessafrica.net/node/975(accessed 17 December 2012)

3.3 Instructional Approaches for teaching of Multigrade Classes

In a multigrade classroom you are expected to spend more time in organizing the lessons. You will also need extra material and strategies to help the pupils/students to learn. You can divide the class into small groups according to their grade levels. Each grade level will be given tasks/assignments relevant to their level which can be done simultaneously.

You can also use the higher grade levels to guide the lower ones. i.e the young can receive help and guidance not only from you the teacher, but from older pupils. You can also identify best pupils/students and share instructional responsibilities with them, and encourage them to share with others in their group, thereby encouraging them to learn from each other.

3.4 Creating an enabling classroom environment in a multigrade setting

The usual arrangement of pupils in rows does not encourage effective interaction between pupils. To create an enabling classroom environment one needs to follow the following steps

3.4.1 Maximizing Classroom Space

The seats can be arranged in a circular or semi-circular form. This creates a physical space that makes pupils comfortable and wants to participate in group discussions. You can also use mats instead of chairs to make pupils more comfortable and everyone will see each other and feel a part of the group.

3.4.2 Use of space outside the classroom

The school grounds are rich in resources and can be used for learning. In the integrated science curriculum the themes “You and your environment” “living and non-living things”, “You and Energy” keep re-occuring with increasing depth in content coverage. The immediate environment outside the classroom can be used successfully to teach these themes.

Each group in a multigrade class can be assigned specific task or activities appropriate for it to carryout outside the classroom

SELF-ASSESSMENT EXERCISE

List some activities that can be carried out outside the classroom

Displaying Pupils work In the classroom

Students work can be displayed creatively on the walls inside the classroom. This makes the classroom attractive despite the different grade levels in the class and makes it more welcoming.
They can even elicit questions from the pupils.

3.5 Teaching Strategies for Multigrades Classes

The most frequently used approach is to teach the groups separately. If one group is receiving instructions from the teacher, the other group will be undertaking group work or individual work. Another approach is to teach the groups at the same time but giving them different levels of activities to suit their age and development. Grouping strategically, you can divide your students into mixed ability groups. This will encourage students of different background to include each other in their work.

You can also group students by age or grade for skill subjects. You can prepare flexible and appropriate materials for teaching. These materials must be varied and made challenging to accommodate the learning needs of students with different levels of ability. You can develop a variety of worksheet, to be used with diverse groups in multigrade classroom situation. These will include teacher guided activity sheets, group learning worksheets and peer directed instruction workshops.

3.6 Active Learning Strategies for Multigrade classes

The following teaching strategies culled from TESSA key resources can be used in multigrade classes

- Round: each pupil has a two or three minutes opportunity to express his or her point of view on a given topic while others listen
- Brainstorm: ask pupils to think individually about an issue or problem for example ‘why is water becoming scarce? Or how can we improve our school? And to list its possible causes, stress that people working together can create more than an individual alone.
- Simulation and games: ask pupils to role-play a situation, ‘what will you do if you were confronted by a bully? By creating

situations that are momentarily real, your pupils can practice coping with stressful, unfamiliar or complex situations.

- Peer teaching: randomly select pupils to find out about a specific topic and then teach the basics of the material to a partner, group or the entire class.

3.7 Advantages of Teaching in Multigrade Classes

1. It helps children especially in remote and isolated areas realize their right to education and therefore learn what they need and want to learn.
2. It is a cost effective approach to providing schooling to children often excluded from the education system
3. It encourage children from different backgrounds to learn with the help of their peers and therefore promotes cohesiveness, cooperation, and healthy competition among students
4. It benefits the multigrade teacher by helping him to plan his work better and be more efficient in the use of time
5. It contributes to student's cognitive development.

3.8 Challenges of Multigrade Teaching

The function of the teacher in a multigrade classroom is much more complicated and demanding than the role of the teacher in a monograde classroom. Most teachers in multigrade classrooms are either untrained or trained in monograde pedagogy.

They have few teaching and learning resources. Another challenge is balancing time and multi-tasking. All these will affect the functions of the teacher in the classroom.
To overcome these challenges efforts should be made by education authorities to train these teachers. They should also try and reverse the teachers negative view about multigrade teaching.

3.9 Assessment and Evaluation in the Multigrade Classroom

Assessment and evaluation are part of the instructional process. They are ongoing and centered both in the classroom and in the daily activities of the students. The assessment of students may be done daily or on a periodic basis depending on the size of the class and the capacity of the teacher to work with each student. It is important to note that assessment is not a one-time event but is cyclical and continuous. It can be done before a new topic, during a lesson, at the end of a topic, or at the end of a term, or the school year.

4.0 CONCLUSION

5.0 SUMMARY

This unit has described the nature and definition of multigrade classroom. It has introduced some useful method/strategies on teaching in multigrade classrooms.

It has also emphasized that all teachings should be student centred and the teacher should make every effort to accommodate the learning needs of each student in the class.

6.0 ASSIGNMENT

Plan a lesson to teach your multigrade class the topic classifying Living Things

7.0 REFERENCES/FURTHER READING

National Teachers Institute (2008): "Teaching Science and Technology in Multigrade Classes" in *An NTI – TESSA integrated Manual for Re-training of Primary School Teachers: Basic Science and Technology*. Kaduna: NTI Press.

UNESCO (2013) Practical Tips for Teaching Multigrade Classes Bangkok: UNESCO.

TESSA (2003); Key Resource: Working with Multigrade Classes http://www.tessafrica.net

UNIT 6 TEACHING INTEGRATED SCIENCE TO MIXED ABILITY GROUPS

CONTENTS

1.0 INTRODUCTION

Students in Integrated Science classroom come from different backgrounds, beliefs, cultures and mental levels. This has implication for the science teacher in the classroom who is responsible for imparting science to the student. In the same classroom, you may find students who can read and write and communicate effectively in the classroom. Again there are some who can neither read no write nor communicate effectively. Hence we have students with mixed abilities in the class. In this unit we are going to discuss how an integrated science teacher can effectively teach science in this type of class.

2.0 OBJECTIVES

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

1. explain the term mixed ability.
2. mention and describe area or skill where mixed ability occurs.
3. suggest ways for effective learning of the subject by the whole group of learners;
4. mention the implications of caring for learners with special educational need.

3.0 MAIN CONTENT

3.1 Mixed Ability Groups

Learners in the science classroom are individuals that come from different backgrounds, different cultures, beliefs, they also have different mental level. Some can read and write and communicate very well while others may not be able to read nor write nor communicate. Some others may have physical challenges such as impaired vision, hearing and motor control. All the students here have different abilities hence the group which forms the class is referred to as mixed ability group.

3.2 Area or Skill of Mixed Ability

In the teaching and learning of science, the mixed ability are in the following areas or skills.

- Manipulative skills
- Communication skills
- Intelligent quotient
- Cultural and religious beliefs
- Sociocultural background
- Socioeconomic background

3.2.1 Manipulative skills

The teaching and learning of science involves handling and manipulating equipment, apparatus and other relevant learning material. Some student may not be able to carry out the experiments involving the science process skills of measuring, handling and manipulating equipment. Some students can safely handle and manipulate heavy equipment, while others cannot. Some students can draw and label specimens while others cannot.

3.2.2 Communication skills

Some students in the classroom can express themselves very well in the language of the classroom while others cannot express themselves. Some can read and write fluently in the same class, while others cannot.

3.2.3 Intelligent Quotient (IQ)

Student have different intelligence quotient (IQ). Some are fast learners while others are slow learners. Also some students are fast writers while

others are slow writers. The implication is that the students do not reason or understand at the same level.

3.2.4 Cultural and Religious Beliefs

Students, come to the classroom with certain beliefs from home. Some are based on religion and superstition, others are based on culture. This makes them to understand science concepts at different levels.

3.2.5 Sociocultural Background

Some students because of their background may not be able to mix and work with other students. For example, where students are taught from home to segregate male from female, boys from girls, it becomes very difficult for them to work in groups or interact in the class.

3.2.6 Socioeconomic Background

Some students because of their background can manipulate equipment e.g. students who have televisions, gas cooker, electric cooker, pressure cooker etc other students may not have this because of their background, so may not be able to manipulate them. In the class where some of these equipment are measured, used and demonstrated, the students comprehension and responses will not be the same

SELF-ASSESSMENT EXERCISE

Describe the effect of socio-cultural background on the effective teaching of science in the classroom

3.3 Implication of Mixed Ability Group in the teaching of science

Individual students in the science classrooms are different in so many aspects. They have individual differences; they behave and respond in different ways based on their belief, culture, interest, orientation and experience.

Since integrated science class is made of mixed ability groups the following suggestions according to Atadoga and Onaolapo (2008)

1. Learners' interest and background should be considered in any learning activities. The learners should be exposed to their immediate environment. they should be able to explore their environment as teachers on their own part make use of materials within the learner's environment, to teach.

2. Mental models and knowledge making skills should be adopted in the teaching of science. This can be enhanced by providing both individual and group learning activities.
3. The learning activities should be graded in difficulty levels according to the learners' knowledge making skills and mental models.
4. The teaching and learning of science should among others adapt science process skills e.g. observation, data collection, experimentation, making hypothesis, drawing, making inference etc.
5. For those with writing, reading and communication problems, they should be grouped and given remediation and tutorial classes.
6. The learners should be group for group learning activities in such a way that the mentally sound be paired or grouped with the less mentally sound ones. Thus they can learn from each other and they will all have a sense of belonging
7. Varieties of learning opportunities be provided so that learners of different IQ can learn from and practice further
8. Every learner should be adequately rewarded as he/she makes effect in any learning activity.
9. Learner's initial activities should involve demonstrations and first hand experiences within their immediate environment.
10. Learners should be given opportunity to discuss what they see happening.
11. Exercise and tutorial should be based on the teachers experiences.
12. Learners should be encouraged to choose their learning experiences that relate to knowledge in science. Formulate hypotheses, design experiments (with control where necessary) and tests. Basically, all levels of learners require descriptive and manipulative works for effective learning of science.

3.4 Caring of students with special education needs in the teaching of integrated science: The role of the science teacher

The integrated science teacher's task is to identify individuals with special needs in his/her class. He/she must constantly check and pay special attention to them in all situations.

The teacher should strive at providing conducive learning environment that will take care of all students with special needs in the science classroom. According to NISTEP (1983), the science teacher should

1. Regularly check their chalkboard writing or work to ensure that it is visible from the backseat

2. Ask the learners to read from the board individually and collectively.
3. Move to the front seats learners who cannot read readily
4. Make their writing clear and large if necessary
5. Reduce too much copying work directly from the chalkboard
6. Ask questions around the classroom from all the learners
7. Be alert to learn their names when they are called upon
8. Move nearer to learners so that they can see the moving of your lips
9. Encourage small group discussions among learners and also small groups practical work
10. Try to get learners to do some manipulative skills
11. Pay attention to learners who have manipulative difficulties
12. Pay attention to learners with difficulty in reading and writing.

4.0 CONCLUSION

5.0 SUMMARY

In this unit we mentioned that the areas or skills where mixed ability groups occur were: manipulative skills, communication skills, intelligent quotient, cultural and religious beliefs, socio cultural background and socio-economic background. We equally discussed the implications of these in the teaching of science. Finally we discussed the role of the science teacher in caring for students with special education needs in the classroom.

6.0 ASSIGNMENT

Discuss the role of the science teacher in caring for students with special education needs.

7.0 REFERENCES/FURTEHR READING

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UNIT 7 LABORATORY FUNCTIONS, SAFETY AND MANAGEMENT IN INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Science teaching in school is becoming more oriented towards a laboratory approach. Students have the responsibility of learning for themselves by carrying out experiments in the laboratory. As in every other sphere of life, there are risks which cannot be eliminated in the use of the laboratory but it can be reduced to a minimum by observing safety rules in the laboratory and adequate management of the laboratory. In this unit we are going to study the functions and safety of the school laboratory and management of the laboratory.

2.0 OBJECTIVES

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

- explain what science laboratory is;
- state at least 3 functions of the laboratory;
- list the general rules of teacher and students;
- identify the various types of precautions to be taken in the laboratory;
- state at least 3 safety precautions to be taken in the laboratory;

- describe various aspects of laboratory management;
- list and explain the various records we should keep in a laboratory;
- formulate general laboratory rules

3.0 MAIN CONTENT

3.1 The science laboratory

The school laboratory can be any place in the school where students learn about the world around them employing their different senses of perception and their mind generating knowledge of their own. This could be the school farm, the school field, the stream near the school, the carpenters shop or a room specially equipped and set aside for the purpose (Mani 1980).
The science laboratory is therefore a room specially equipped and set aside for the purpose of carrying out science experiments.

3.2 Functions of the science Laboratory

The school science laboratory has many functions. They enable the student to:
(a) Learn the acquisition of knowledge about the world around us
(b) Acquire the several skills of the practicing scientist such as to:
- Handle or construct apparatus
- Make measurement
- Make observations
- Handle data
- Record results and make inferences, discern patterns and draw conclusions
- Formulate problems
- Carry out experiments and investigation
- Work effectively either independently or as a group
- Develop scientific attitude and interest.

SELF-ASSESSMENT EXERCISE

What are the functions of a science laboratory?

3.3 Safety measure to be taken in a science laboratory

3.3.1 Guidelines and rules for storage and safety in the laboratory must put into consideration the hazards that are associated with the materials handling, such as shock from high voltage, suffocation from poisonous gases, cut from sharp objects, burn from explosions and fire etc.

Everyone working in a laboratory needs to be made aware that he has responsibility for the safety of others working alongside him as well as his own safety.

3.3.2 General preventive measures to ensure safety in the laboratory

The following are some of the general preventive measures taken to prevent accident in the science laboratory

1. Students should not have access to the laboratory except you the teacher or the laboratory technician is around
2. You the teacher should always be the last person to leave the laboratory after each lesson. This is to ensure that the laboratory assistant turns off the gas, water, electricity and cleans up
3. A suitable fire extinguisher, a fire cupboard for noxious or unpleasant gases, a sand bucket, a fire blanket etc must be provided in the laboratory to curb all sorts of accidents in the laboratory
4. The design of the laboratory should allow free movement to supervise the students
5. The students should not be too overcrowded in the laboratory so that you can control them
6. The fitting on the laboratory walls and floor should not stick out into the pathway in the laboratory.
7. The main control for the gas, electricity and water should be accessible to you and the students to operate in case of emergency
8. The laboratory should be kept clean and safe. A daily routine of duties for the laboratory assistant should be designed.
9. First aid-kits should be made available to students, laboratory assistants and other teachers.

3.3.3 Rules and regulations for laboratory staff

Below is a set of rules you must follow while working in the laboratory

1. Never eat, drink or smoke in a laboratory
2. Always wear your overall coat at every practical lesson
3. Get familiar with the locations of fire alarm, first aid kit, fire extinguisher, telephone and other safety equipment
4. Get familiar with the position of the main switches for water, gas, and electricity supply to the laboratory
5. Long hair or head ties should be well packed and avoid lose jewelry in the laboratory
6. Be familiar with the emergency route and procedure
7. Avoid looking into the mouth of the test tube while heating or adding reagents

8. Ensure there are no obstruction with the door ways and emergency exists
9. Never allow your students to work alone in the laboratory without supervision
10. Always wash your hands before leaving the laboratory
11. While diluting strong acids, pour the acid a little at a time to water. Never add water to acid
12. Never try to slow down or stop a centrifrige with your hand
13. Always label containers accurately with the name and concentration of contents
14. Avoid testing chemicals or eating seeds or plants meant for biological practicals
15. Do not sniff materials that may be toxic
16. Always use the fume chamber in carrying out experiment that produces harmful gases.
17. Do not handle materials or operate equipment you are not familiar with
18. All apparatus not in immediate use should be kept in cupboards
19. Make sure the laboratory is kept clean after each practical exercise
20. Make sure all services e.g gas, water, electricity are put off at the end of the days work
21. Inform other staff of any breakage, faulty equipment and other defects
22. Check that all Bunsen burners are put off and there is no naked flame before using flammable solvent

3.3.4 Protective devices for the staff

Some of the protective devices that can be used by staff include safety spectacles, Gloves, safety shoes, lab coats and aprons

3.3.5 Hazardous Chemicals

Hazardous chemicals can be classified into explosives, gases, flammable liquids, flammable solids, oxidizing substances, poisonous and infectious substances, radioactive substance, miscellaneous dangerous substances.

SELF-ASSESSMENT EXERCISE

List 3 safety devices for staff and describe their uses

Some hazard signs you and the students need to know are shown in fig 7.1 below

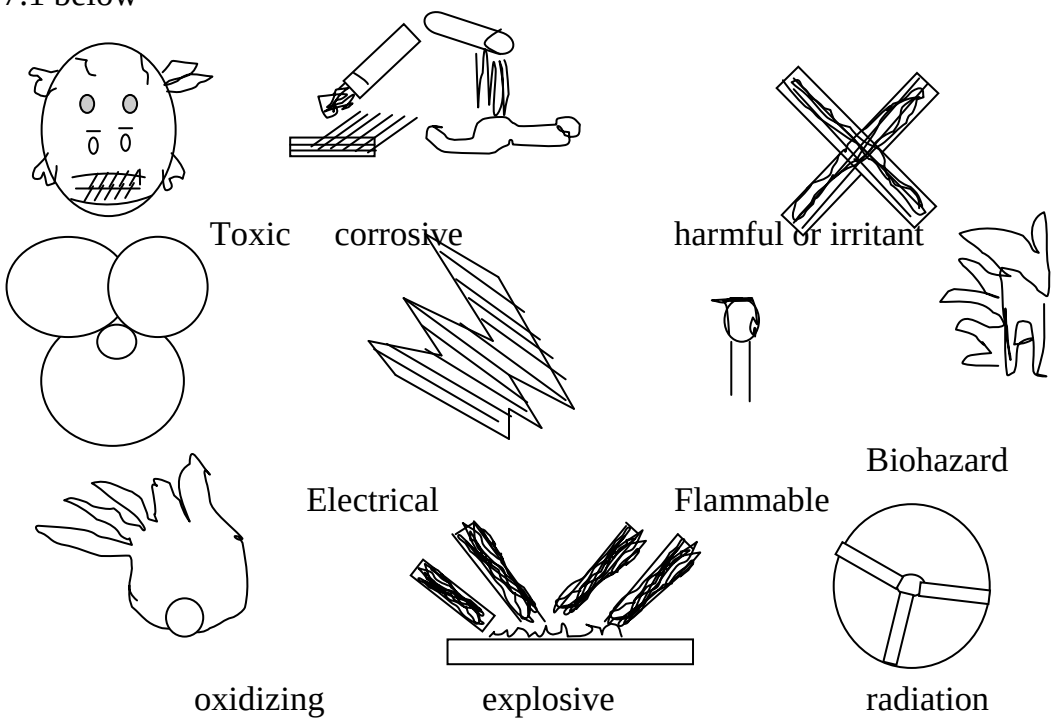

Fig 7.1: Common hazard signs

SELF-ASSESSMENT EXERCISE

Draw the hazard signs to show biohazard, explosives and radiation

3.4 Laboratory Management

Good management of facilities and resources is important for the effective use of the laboratory. An integrated science teacher should see proper management of the laboratory as an important part of his daily duties.

3.4.1 Role of the Head of Department

In the school setting the Head of Integrated Science department is in charge of the Integrated Science Laboratory.
He is the one that organizes and coordinates the duties of all the teacher in the department. The head of department is responsible for the following

1. development of the integrated science laboratory time table
2. integrated science teachers time table
3. science club activities announcements and general information

He often delegates duties by identifying staff members with their talents and capabilities

3.4.2 Role of the Science Teacher

The science teacher is responsible for the following

1. **Preparation of materials, solutions and specimens:** It is the duty of the integrated science teacher to operate all necessary materials or items for practical lessons
2. **Training of laboratory assistants:** The laboratory assistants should be well trained because students directly or indirectly learn a lot from them. They should attend workshops regularly.
3. **Stock control, requisition and receipt of supplies:** As a science teacher, you should make sure, you record the incoming and outgoing stock in your stock book. Have a requisition book for your request and always issue a receipt or sign for supplies made to the store room.
4. **Recording Damages and Breakages**: Damages and breakages should be recorded in this book for replacement where possible, glass wares such as test tubes, beakers etc break all the time.
5. **Accident and First Aid Books**: This book should contain the name of the student involved in the accident, cause of the accident, first aid administered, date of accident and signature of the first aider
6. **Proper Storage and Distribution of Materials**: Materials should be stored according to their nature. The storage procedure should be simple for safety and ease of retrieval.
7. **Implementation of Safety Regulations**: It is the duty of the science teacher to ensure that students and other support staff keep the safety rules and regulations.
8. **Supervision and Control of the Laboratory Assistant**: The science teacher should draw up the duties of the laboratory assistant and supervise and control him at all times to ensure safety in the laboratory.

4.0 CONCLUSION

5.0 SUMMARY

In this unit you learnt about the functions of the science laboratory, safety measures to be taken in the laboratory, general preventive measures and rules and regulations for laboratory staff to ensure safety in the laboratory.

You also learnt about the different hazard signs and how to effectively manage a science laboratory.

6.0 TUTOR-MARKED ASSIGNMENT

i. State the 8 classes of hazardous chemicals
ii. List two ways in which your body can contact chemicals in the laboratory

7.0 REFERENCES/FURTHER READING

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UNIT 8 IMPROVISATION IN THE TEACHING OF INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Scientific equipment are necessary materials in a science laboratory for the use of students to aid learning. The bane of integrated science laboratories are the lack of enough and adequate equipment for the teaching and learning of science. It is expected of a good integrated science teacher to be able to improvise scientific equipment/apparatus where necessary to enable the students to learn. In doing this, the teacher must be resourceful and willing to improvise. In this unit you will learn how to collect and make some simple apparatus for science teaching.

2.0 OBJECTIVES

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

- explain the meaning of improvisation;
- explain the need for improvisation;

- mention at least 10 resources for improvisation;
- describe the application of improvised materials in integrated science teaching;
- list the advantages of improvisation;
- mention the limitations of improvisation

3.0 MAIN CONTENT

3.1 Concept of Improvisation

Improvisation is the act of using alternative materials and resources, due to lack or insufficiency of some specific first hand teaching aids to facilitate instruction. In most schools, teaching aids or science apparatus are not readily available therefore the resourceful and innovative science teacher will have to design a replica of such materials to make them function or play the role of the real objects using the available material. This act is called improvisation.

Improvisation requires developmental thought, imaginative planning and good knowledge. According to Adamu (2003) improvisation helps the following aspects of learning:

1) Perception
2) Understanding
3) Transfer of training
4) Provide reinforcement and
5) Retention

3.2 The Need for Improvisation

According to Alonge (1983), the need for improvisation among many others include

1. A way of minimizing cost of equipment
2. Inexpensive method of widening the scope of enquiry
3. Challenge to curiosity and productive application of intellect
4. A means of local application of universality of science
5. Developing necessary science skills, process skills attitudinal and practical skills needed to function effectively in the society as a professional scientist
6. Enable the teachers to think and research for cheaper, better and faster methods of making the teaching – learning process easier for students hence promote creativity, and self reliance
7. Provide a cognitive bridge to lead students from abstraction and its attendant or mental indigestion to a nodding acquaintance with reality.

In Nigeria, the explosion in school enrolment, and the poor state of the nation's economy create a serious scarcity of science equipment. Therefore there is the need to provide substitutes for conventional science equipment.

Improvisation is also necessary because children are likely to show greater interest and participation in science lessons if they cooperate in the production of the local materials used for the lesson.

SELF-ASSESSMENT EXERCISE

1. Explain why we improvise in our science teaching
2. Look through your class integrated science syllabus and make a list of some of the equipment or materials that are lacking.

3.3 Resources for Improvisation

Raw materials that can be used for improvisation are found everywhere in our environment. The home, the school, farm, mechanics workshop, market, carpenters shed, blacksmiths shed, welders sheds are all ready sources of raw materials for improvisation.

Listed below are some raw materials that can be used for improvisation. Jugs, spoons, forks, pots, biros, cans, plates, cartons, magazines, motor parts, bicycle parts, bottles, calendars, match boxes, paper, bottle tops.
It only requires the commitment and resourcefulness of the integrated science teacher to explore all possible sources for the required materials. Table 8.1 below shows some specific improvisations in integrated science.

Table 8.1: Some specific improvisations in integrated science

Improvised	Item used	Functions of item
Beaker	Jam jars, cream jars, Tumblers, glass cups	Used as beakers containers for liquids chemicals and solutions
Burners	Hurricane lamp using spirit, candles, kerosene stove	For heating
Funnels	Plastic bottles opened at the base	For transferring liquid
Dropping pipette	Dropping teat of ear/eye drop	Adding indicators or liquids in drops
Chromosome	Strip of cardboard, wood and paint	Illustrating genetics
Models of organisms	Marshed paper, starch,	Representing the

of organs	paint or coloured ink	organism or showing the organ looks
Insect catching nets	Mosquito net, wooden or aluminium ring	Catching insects
Circuit board	Plywood, metal strip, wire, torch light, bulb, batteries and paper clip	For experiments on conversation of chemical energy to light
Concave/convex mirror	Base of empty insecticide cans	Experiments on light
Prism	A glass of water	For colour spectrum
Polygons and other geometrical shapes	Cardboard or metal sheet well cut into fitting shapes, gum.	For teaching geometry
Molecular models	Coloured beads, tennis egg, gum	To teach bonding in molecules

Source: A Handbook on science teaching methods
Vol. 1 by Atadoga M.M and Onaolapo M.A.O

3.4 Method of Improvisation

3.4.1 Improvising teaching material through material substitution

The use of most of the local materials listed above is done through substitution. This is because an already existing local material is used in place of a piece of equipment that is not available. For example beakers are replaced by jam jars, bottle tops used to replace funnels etc.

SELF-ASSESSMENT EXERCISE

List a few examples of science apparatus that you can improvise through substitution process.

3.4.2 Improvising Teaching Materials through Construction

It is not possible to find suitable substitute for every piece of science equipment in the laboratory. The topics requiring the use of these apparatus have to be taught. In this situation the teacher in forced to construct a new instrument to serve the purpose.

We will now look at the construction of a few teaching materials to illustrate how original pieces of equipment can be improvised in the school

3.4.2.1 Construction of an Insect net

Materials
This can be made from a broom or mopper handle, some heavy wire and mosquito netting.

Procedure
Read the wire into a circle of about 35 to 45cm in diameter

1. Twist the ends together to form a straight section at least 15cm length
2. Then fasten it to the end of the broom or mopper handle
3. Cut a piece of mosquito netting to form a net about 75cm deep
4. Sew a piece of cloth to the cut edge of the net
5. Then fasten it to the circular wire fram by stitching.

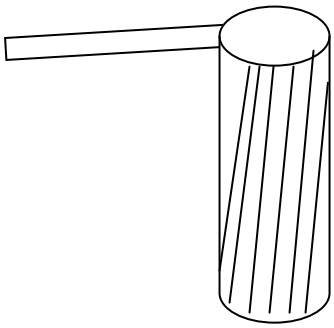

Fig 8.1: An insect net

3.4.2.2 Construction of a can-burner

Materials
Empty bournvita or ovaltine tin, with lid, a wick, kerosene or palm oil

Procedure

1. Make between 3 and 6 holes on the upper half of the body of the tin
2. Make another hole at the centre of the tin lid
3. Put some kerosene or palm oil into the tin
4. Insert the wick into the hole of tin lid

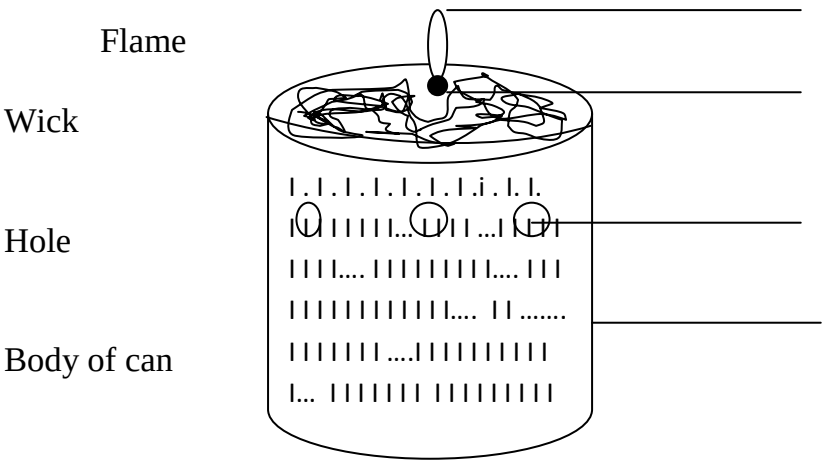

Fig 8.2: A can burner

3.4.2.3 Construction of a simple pulley

Materials
Clothes hanger and cotton reel

Procedure
1. At a distance of about 20cm from the hook of the hanger, cut off both wires of the hanger
2. Bend the ends of each of the two wires at right angles and pass them through opposite ends of the cotton reel
3. Make the wires such that they would permit easy turning of the reel.

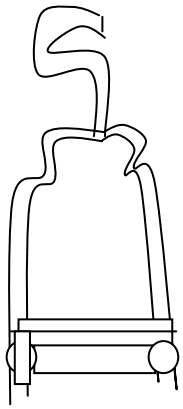

Fig 8.3: A sample pulley

3.4.2.4 Construction of Improvised Aquarium

Materials – medium sized strong cardboard box, large transparent plastic, razor blade or sharp knife, marker pen, paper clips, marking tape.

Procedure

1. Mark and cut two windows in each long side and one on each short side
2. Fold the top flaps inside and cut off any bits that cross the windows you have cut.
3. Tape down the top flaps firmly inside the box
4. Place the plastic bag into the box pressing it firmly right down into the corners
5. Fold it over the top of the box and fasten it down with paperclips
6. Put a layer of sand in the bottom making sure that the plastic is in contact with the cardboard at all points particulars the corners
7. Move box to its permanent home position
8. Fill carefully with water and adjust plastic as necessary
9. Trim off the excess plastic and fasten it down with tape

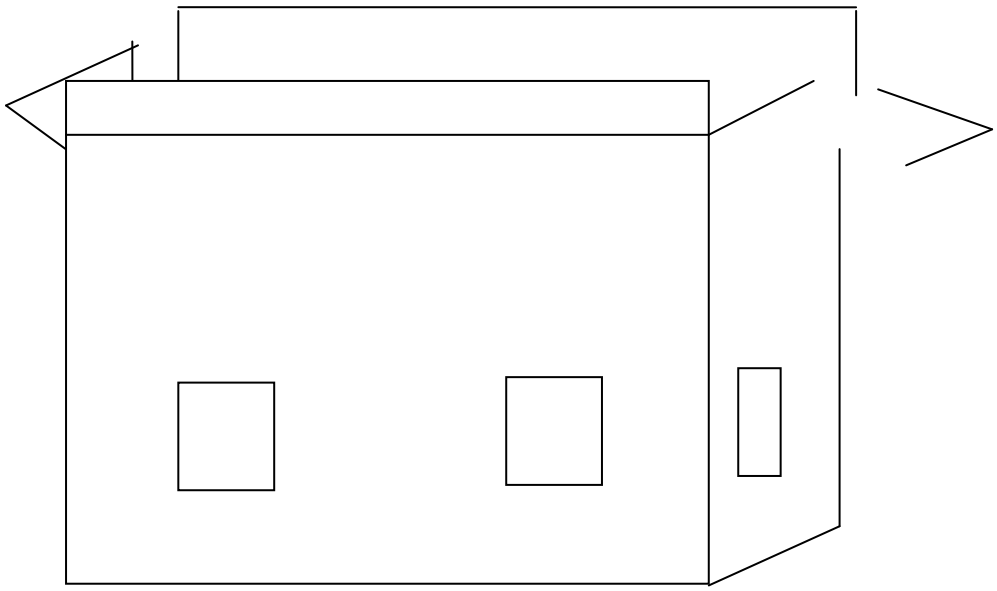

Fig 8.4: Improvised Aquarium

The improvised aquarium is now completed and can be used to preserve some fishes

3.5 Integration and Application of Improvised Materials in Teaching

This is the systematic step by step presentation or application of improvised materials in teaching. The application of the materials must be done carefully and tactfully.

According to Shabani & Okebukola (2001), there are four basic steps to follow

1. Preparation of the teacher
2. Preparation of the students

3. Actual presentation
4. Preparation of follow up activities

3.5.1 Preparation of the Teacher

- The teacher has to process the materials well ahead of time
- Consider how the material can help in achieving the objectives of the lesson
- Plan the integration in the lesson and follow it

3.5.2 Preparation of Student

- Students must be prepared psychologically with some explanation and reasons for the particular materials to be used.
- There should be clear guidance about the areas of importance to study and step by step directions of what students need to do during the lesson
- New words or terms associated with the material must be defined clearly.

3.5.3 Actual Presentation

The improvised material must be appropriately applied at the different stages viz introductory, content presentation and summary
The teacher must be careful not to allow the students to loose sight of its objectives since the main reason for the improvisation is the achievement of stated objectives.

3.5.4 Preparation of follow-up activities

The teacher must evaluate the success or otherwise of an improvised instructional material. This he/she can do by obtaining feedback from the students.
The teacher should ask questions that relates directly to the presentation and allow the students to respond freely at every stage of the lesson

4.6 Advantages of Improvisation

According to Atodoga & Onaolapo (2008) the advantages of improvisation includes:

1. If managed effectively and appropriately, it will increase the rate of learning and will allow the teacher to use more time on other useful activities

2. It encourages the involvement of teachers in curriculum design and development
3. It allows for effective lesson planning from objective determinations and evaluation
4. It encourages students participation in the process of learning
5. It makes room for individualizing education as alternative paths and variety of resources are available at the learners choice
6. Learning becomes real and immediate because improvised instructional aids utilization emphasizes understanding and practical activities. Improvisation provides bridge for the world outside and inside the classroom.
7. Improvised instructional materials utilization makes access to science education more equal and plentiful for all learners, since improvised materials can be moved from place to place
8. Provision of various, improvised instructional materials helps the child to discover himself and his true ability.
9. Visual support is very helpful in the teaching and consolidating vocabulary which in turn affects the reading ability of students and can help students to associate words and objects or comprehend what is happening in a particular concept or area of study (Adamu 2003)
10. Improvisations are very useful and dependable in capturing students imagination if used correctly. If effective selection is made, it will motivate students to learn and remember what is learnt, whenever there is need to recall
11. An improvised material can present the students with a more authentic picture of the real object, than the teacher can ever describe or explain
12. The use of improvisation can also facilitate the repetition of an idea without becoming monotonous (Balogun 1981).

3.7 Limitations of Improvisation

1. Improvisation depends on the ability and skills of the teacher
2. Degree of accuracy and precision may be doubtful
3. Durability, cleanliness or compatibility of the material may not be guaranteed.
4. Availability of funds may be a limiting factor
5. Lack of professional commitment, competence, creativity, mechanical skills, initiative and resourcefulness of the teacher
6. Negative attitude towards improvisation by the teacher

4.0 CONCLUSION

5.0 SUMMARY

In this unit you learnt that science equipments are improvised when they are not available in the laboratory
Some resources which can be used to substitute real science equipment include jam jars, tumblers, Hurricane lamps kerosene stove, dropping teat etc

- Some improvised instructional materials can be constructed such as aquarium, insect net, simple pulley and can burner
- Improvisation if managed effectively will increase the rate of learning but its limitation depends on the ability and skills of the teacher amongst others.

6.0 TUTOR-MARKED ASSIGNMENT

i. Describe the construction of at least two improvised teaching materials
ii. List the advantages of improvisation

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UNIT 9 EVALUATION AND ASSESSMENT IN INTEGRATED SCIENCE

CONTENTS

1.0 INTRODUCTION

Evaluation is the estimation of worth of a thing, process or programmes in order to find out the extent of achievement of the thing, process or programme. In this unit you will be introduced to the meaning, purpose and importance of measurement and evaluation, Emphasis will also be laid on continuous assessment, types of tests, test construction, marking and grading.

2.0 OBJECTIVES

At the end of this unit you should be able to:
1. define evaluation
2. describe and distinguish between the two forms of evaluation
3. give reasons why it is important to evaluate
4. construct some test items in integrated science
5. describe some continuous assessment procedures

3.0 MAIN CONTENT

3.1 Evaluation

Gronlund (1971) defines evaluation as the systematic process of determining the extent to which educational objectives are achieved by learners.

Cowie and Bell (1996) defined evaluation as "the process used by teachers and students to recognize and respond to student learning in order to enhance that learning during learning".

Again Sadler (1989), Gipps (1994) and Black and William (1998) see evaluation as the teacher giving feedback to the students, the teacher and (or students) taking an action to improve learning during the learning and self assessment.

Evaluation is a measurement of the extent to which objectives set for a particular event have been achieved. Evaluation in education is to inform and improve students ongoing learning (Busari 2004).

SELF-ASSESSMENT EXERCISE

(a) What do you understand by evaluation?
(b) Why is it important to evaluate

3.1.1 Purpose of Evaluation

The major purposes of evaluation are to:

i. Diagnose learners difficulties,
ii. Appraise teacher's instruction
iii. Check learners progress and guide accordingly through the feedback
iv. Assess instructional programmes.

Evaluation has been linked to improved learning and standard of achievement. It is also an important aspect of teaching for conceptual development. Evaluation helps to give feedback to students about their existing concepts and also helps them to modify their thinking.

3.1.2 Forms of Evaluation

There are two forms of evaluation, formative evaluation and summative evaluation.

4.1.2 Formative Evaluation

This is a periodic, intended or development, meant to enhance teaching and learning. An example of this is Continuous Assessment.

4.1.2.2 Summative Evaluation

This is the usual terminal assessment of student's performance.
Examples are terminal examinations, end of semester examinations, sessional examinations

SELF-ASSESSMENT EXERCISE

1) What are the two forms of evaluation?
2) Distinguish between the two.

3.2 Nature of Continuous Assessment

One of the distinguishing features of the National Policy on Education is its emphasis on Continuous Assessment.

The Science Teachers Association of Nigeria in 1979 defined Continuous Assessment as a mechanism whereby the final grading of a pupil in the cognitive, affective and psychomotor domains of behavior takes account in a systematic way of all his performances during a given period of time.

In general Continuous Assessment is a method of finding out what a student has gained from learning activities on a continuous basis in a given period of time.

3.2.1 Characteristics of Continuous Assessment

The characteristics of Continuous Assessment include being systematic, comprehensive, cumulative and guidance oriented.

3.2.2 Techniques for Continuous Assessment

The techniques for Continuous Assessment include the following:

1. Testing Technique: This is the technique of giving the students pencil and paper test at the end of a lesson or unit to obtain data on his abilities.
2. Written assignment: The student here is given some exercise to write at his own time and this is later assessed by the teacher.

3. Peer Evaluation Technique: Here each student is requested to assess others.
4. Self Report Technique: Here each student is requested to assess himself in terms of how much he benefited from the lesson
5. Observational Technique: In this technique the progress of a student in a learning situation is determined by keeping a systematic record of the various kinds of behaviour and attitude exhibited by the student
6. Assessment of Project: This is a means of assessing the progress of a student by evaluating the student's physical product.
7. Oral Exchange of Questions: Here the teacher uses the student's answers to his questions and questions students ask in the class to assess the student's progress.
8. Assessment of practical skills: this is a technique in which the progress of a student in acquiring manipulative skills is assessed.

3.2.3 Merits of Continuous Assessment

The merits of Continuous Assessment includes the following

1. It gives the science teacher a greater involvement in the overall performance of students.
2. Provides a more valid assessment of students overall knowledge, skills and attitudes
3. Enable the teacher to be more flexible and innovative in their instruction
4. Provides a basis for more effective guidance of students
5. Provides a basis for the teacher to improve his or her assessment tools.
6. It is diagnostic, providing correct feedback to both the teacher and the learner
7. It diminishes error of measurement

SELF-ASSESSMENT EXERCISE

What are the characteristics of Continuous Assessment

3.3 TEST ITEMS CONSTRUCTION

There had been several tests that failed to achieve their initial objectives. This might be because they are ambiguous and not clear enough. In constructing tests, it is necessary for the teacher to first determine the type of test or evaluation technique to use and the specific content areas and corresponding topics.

The teacher then prepares a blue print or table of specification. This table shows the number of items that will be asked under each topic or content and the process objective.

The items in the test must be written in a clear language.
Adequate time for answering the questions should be given and a marking scheme must be prepared by the teacher and should exhaust all possible answers to the items

Table 1.1: Blue Print/Table of Specification

	Process Objectives						
Content	Knowledge	Comprehension	Analysis	Synthesis	Application	Evaluation	Number of items
A soil 25%	30% 4	30% 4	10% 1	10% 1	10% 1	10% 1	10% 12%
B water 20%	3	3	1	1	1	1	10
C weather 30%	4	4	2	1	1	2	15
D Food 25%	4	4	1	2	2	2	13
Number of Items	15	15	5	5	5	5	50

33.1 Types of Tests

The different types of tests include personality tests and ability tests. Ability tests can be further divided into aptitude tests and achievement tests.
There are two basic types of achievement tests:
1) Essay type of tests
2) Objective tests

Essay Type of Tests

The essay test is a free response test where the learner is given the freedom to express his or her points
Example: Draw and describe the functions of the human ear.
Essay tests are useful for assessing a few areas in depth and for assessing the learners ability to syntheses and evaluate.

The disadvantage is that it can be time consuming, tedious to score and often subjective and inconsistent or unreliable

There are two major types of scoring: the analytical method and the holistic method

The analytical method is the most frequently used in integrated science. In this method, points are assigned to each fact the learner supplies to test items. Usually the points range from ½ to 1. The points which correspond to what is in the marking scheme is credited to the respondent.

Scoring of Essay tests

There are two major types of scoring: the analytical method and the holistic method:

The analytical method: is the most frequently used in integrated science. In this method, points are assigned to each fact the learner supplies to test items. Usually the points range from ½ to 1. The points which correspond to what is in the marking scheme is credited to the respondent.

Holistic method: involves reading through an answer and giving a single mark at the end of the general reading. This method may involve the use of broad idea which are assigned large number of mark as compared to small marks of analytical method. This method is frequently used in subjects like History, Literature and English Language

Marking/Grading Guidelines for Essay

Whichever method is used, the following guidelines will be useful

1. Prepare your marking scheme as soon as you construct the test items
2. Mark according to your marking scheme, do not be influenced by a candidates handwriting or any other feature not in the marking scheme
3. Mark all responses to each questions at the same time i.e mark all scripts with question 1 at the same time before moving to another question
4. Adopt the strategy work-rest-work
5. Avoid working when you are tense or tired, angry, annoyed, or unhappy.

Objective Tests

Objective tests are fixed response test. Unlike the essay test, objective tests provide answers from which a learner has to choose.

Varieties of objective tests include
1. Multiple choice tests
2. True or false
3. Matching questions
4. Completion

For the first three listed above, a question is usually asked and options are provided but for completion test, the learner supplies the answers

Multiple Choice Tests

Example: identify the group that is not a vertebrate
A. Mammals
B. Fishes
C. Amphibians
D. Insects
E. Reptiles

True or false

HIV/AIDs is a hereditary disease: true or false.

Matching Questions

A	B
1. Filtration	a. Water borne disease
2. Gold	b. Metabolic activity
3. Guinea Worm	c. Mineral
	d. Methods of separating Mixture
	e. Air borne disease

Completion

Tsetse fly is a vector of _____

The advantages of objective tests is that
i. it can cover a wide area of topics taught
ii. scoring is easy, fast, reliable and objective
iii. they are good for testing skills to find out how much knowledge have been acquired

4.0 CONCLUSION

5.0 SUMMARY

In this unit you learnt about the definition, purpose and importance of evaluation and assessment. The differences between formative and summative evaluation were highlighted and the description of Continuous Assessment a form of formative evaluation were given.
You also learnt about the various types of tests, and their construction, scoring and preparation of marking schemes.

6.0 ASSIGNMENT

i. What is evaluation?
ii. Differentiate between formative and summative evaluation
iii. What are the advantages of Essay type tests?
iv. As an integrated science teacher select some topic for the J.S 2 2nd term examination and developed the examination questions

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UNIT 10 CONSOLIDATION

CONTENTS

1.0 INTRODUCTION

This module introduced you to difficult topics in Nigeria Integrated Science curriculum. You will recall that in units 1 to 9 we discussed preparation for teaching integrated science, effective communication and interaction, the use of team and micro teaching, management of large classes, multigrade classes, and mixed ability groups, laboratory functions, safety and management, improvisation and the basics of creativity in an integrated science classroom. In this unit we are going to summarize and highlight the major ideas discussed in this module.

2.0 OBJECTIVES

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

- describe units of instruction;
- explain the concept of Team and Micro Teaching;
- describe the importance of language to integrated science;
- manage large classes;
- teach in a multigrade classroom;
- manage a science laboratory;
- carry out improvisation in integrated science; and
- give reasons why it is important to evaluate

- describe techniques to aid creativity in an integrated science classroom

3.0 MAIN CONTENT

3.1 Preparation for Teaching Integrated Science Lessons

Curriculum and instruction are conceived as a unified whole. Curriculum is a written document of experience which are provided to the learners while instruction is the process whereby the environment of an individual is manipulated to enable him or her to learn to is directly derived from the syllabus. The lesson plan or note is drawn from engage in specified behaviours under specified conditions. The school syllabus is derived from the curriculum and is more or less an examination conscious document. The scheme of work: It is the final state in curriculum implementation.

SELF-ASSESSMENT EXERCISE

What are the components of a lesson plan/note

4.2 The use of Team and Micro-teaching in Integrated Science

There is the need to adequately prepare integrated science teachers in the light of changes in the curriculum and teaching methods. Two instructional approaches that are receiving greater attention are team teaching and micro teaching.

Team teaching is a teaching strategy involving a group of teachers who are jointly responsible for the planning and teaching of a course, with each member of the team having a specific role to perform.

Micro teaching is a training strategy used in teacher training colleges to promote desirable teaching skills of prospective teachers. It is a model of the normal teaching practice but with slightly different objective.

SELF-ASSESSMENT EXERCISE

Differentiate between Team Teaching and Micro Teaching

4.3 Communication and Interactions in Integrated Science Classroom

There are different ways one can communicate in a classroom. This includes the use of language, which is verbal, and the use of signs or

body language which is non-verbal. However language encloses the several ways of communication. Language is a problem in teaching and learning science especially when the language in the text book is a second language, different from the mother tongue or first language of the students.
Mother tongue or local language of the environment should be used for teaching at the lower basic level while English language should be used at the upper level.

SELF-ASSESSMENT EXERCISE

How does mother tongue or local language pose a problem for students who learn science in a second or third language?

4.5 Management of large Classes in Integrated Science

Some of the teaching strategies that could be used in large classes include; class activities; demonstration method, project method, ICT applications and team teaching.
In managing large classes the science teacher must have competences such as

- ability to learn and use students names
- ability to establish rapport with the students
- being patient and affirmative with students
- promote an environment of trust and mutual respect to prevent the fear of peer judgment.

SELF-ASSESSMENT EXERCISE

Mention any two strategies for managing large classes

4.5 Managing Multigrade Classes

Multigrade classes as we learnt in unit 5 are classes where you have children of different ages and different grade levels.

The multigrade phenomenon occurs due to economic constraints or shortage of teachers. Other names given to multigrade classes include: double classes, split classes, vertically grouped classes, mixed age classes and composite or combination classes.

Multigrade classes help children to realize their right to education and, therefore, learn what they need and encourages children from different backgrounds to learn with the help of their peers.

Multigrade classes benefit the teacher by making him to plan his work better and be more efficient in the use of time. It also contributes to students' cognitive development

SELF-ASSESSMENT EXERCISE

Give 2 challenges of multigrade teaching

4.6 Managing Mixed Ability Groups

Mixed Ability groups as we learnt in unit 6 are classes where you have students that come from different backgrounds, cultures, beliefs and also different mental levels. Some can read and write and communicate while others cannot. The areas or skills where there are mixed abilities include manipulative skills, communication skills, intelligent quotient, cultural and religious beliefs, socio cultural and socio economic background. The implication of this is that learner's interest and learning activities. The integrated science teacher's task is to identify individuals with special needs and abilities in his or her class and constantly check and pay special attention to them. The teacher should strive at providing conducive learning environment for all the students.

SELF-ASSESSMENT EXERCISE

List the areas or skills where there are mixed abilities

4.7 Laboratory function, safety and Management

Science teaching in school is becoming more oriented towards a laboratory approach.

The science laboratory is a room specially equipped and set aside for the purpose of carrying out science experiments.

The functions of the science laboratory are to enable the students amongst others to learn about the acquisition of knowledge about the world around us and acquire several skills of the practicing scientist.
As in every other sphere of life there are risks which cannot be eliminated in the use of the laboratory but it can be reduced by observing safety rules in the laboratory.

In managing the laboratory the science teacher or head of science department must create a laboratory time table and keep proper records of materials, stock control, accident and First Aid Books.

SELF-ASSESSMENT EXERCISE

List the general preventive measures to be observed in the science laboratory

4.8 Improvisation in the teaching of Integrated Science

Improvisation is the act of using alternative materials and resources, due to lack or insufficiency of some specific first hand teaching aids to facilitate instruction. Improvisation requires developmental thought, imaginative planning and good knowledge.

Raw materials that can be used for improvisation are found everywhere in our environment.

These raw materials may include: jugs, spoons, forks, pots, biros, cans, plates, cartons, magazines, motor parts, bicycle parts, bottles, calendars, match boxes, paper and bottle tops.

Two methods of improvising are substitution and construction.

SELF-ASSESSMENT EXERCISE

List a few examples of science apparatus you can improvise through substitution process.

3.9 Evaluation and Assessment in Science

In unit 1 you learnt that evaluation is the estimation of the worth of a thing, process or programme. The two forms of evaluation are formative and summative evaluation. Formative evaluation is carried out during the teaching process while Summative evaluation is done at the end of the lesson or end of the term.

Continuous Assessment is a form of formative evaluation that gives the teacher a more valid assessment of students overall knowledge, skills and attitudes. Achievement tests are the most frequently used tests in assessment. The two types of achievement tests are essay type and objective tests.

In constructing tests it is important to prepare a table of specification which shows the number of items that will be asked under each topic or content and the process objective.

SELF-ASSESSMENT EXERCISE

What are the two forms of evaluation?
Distinguish between the two.

4.0 CONCLUSION

5.0 SUMMARY

In this unit you have reviewed units 1 – 9 to consolidate the concepts in the different units.

6.0 TUTOR-MARKED ASSIGNMENT

i. Describe the techniques DO IT
ii. What causes large classes
iii. List the other names given to multigrade classes.

REFERENCES/FURTHER READING

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