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MODULE 1

UNIT 1 MATHEMATICS ITS IMPORTANCE AS A DISCIPLINE AND IMPLICATION FOR SCHOOLS CURRICULUM

CONTENTS

1.0 INTRODUCTION

In this unit, you shall be taken through the importance of mathematics as a discipline and the implication it has for its Curriculum.

2.0 OBJECTIVES

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

(i) Tell in your own words why mathematics is important as a discipline.
(ii) Relate how mathematics is useful to an individual.
(iii) Point out the usefulness of mathematics in the environment.
(iv) Relate how mathematics aids the study of science and social science subjects.
(v) Relate the usefulness of mathematics in technology and industries.

3.0 MAIN CONTENT

3.1 Mathematics an Important Discipline

The fact that mathematics is an important subject is not gainsaying. Even an ordinary man on the street will agree to this fact. Indeed mathematics is an important and necessary subject for progress in anywhere in the world. It is a subject that cannot be divorced from the world of Technology which is a key to progress and development. It has been aptly described as the queen and servant of all subjects Johnson and Rising (1972) have noted that

"… No other subject has greater application than mathematics. It is the prime instrument for understanding and for exploring our scientific, economic, and social world. Today more than ever before, all fields of knowledge are dependent on mathematics for solving problems, stating theories and predicting outcomes. It is an indispensable tool in creating new knowledge."

Nigeria like other developing nations is making a swift move towards technological development. However, any laudable achievement in technological development will be hampered if the potential Scientists, Engineers and Technologists are not equipped with sound knowledge of mathematics. Olorundare (1979) noted "the pursuit of science and the gaining of an understanding of it are seriously hampered if the person concerned is not mathematically secured." And indeed hardly is there anything for which the assistance of the subject (i.e. mathematics) is not sought.

3.1.1 Mathematics in an Individual's Life

Every individual needs some knowledge of mathematics today, even if for economic survival. For example, it is necessary for an individual to be able to handle daily money transactions in which he is involved. He needs to be able to read public information meant to guide or instruct the

populace; he needs to be able to budget his personal income accurately enough to be able to make ends meet; there is also need for him to be able to plan and calculate his purchases when he goes shopping to determine his correct change.

In the aspects of professional duties, a business person should be able to keep simple financial accounts of his business transactions, a carpenter should be able to use appropriate instruments e.g. the calculation of wood needed for specific objects; a Tailor needs to know how to measure to be able to determine length of materials needed for various garments, even an housewife estimates the quantity of food to cook for the household.

All the above are possible only if the individual concerned is mathematically literate to a level.
Generally, mathematics enables an individual to reason well, and to interact in the society with a cultivated mind. It trains the reasoning faculty, thereby helping to develop intelligence; it enables an individual to think for himself and solve his own problems.
Indeed, it will be difficult for anyone who is mathematically illiterate to function and interact well in today's world because such an individual will be severely handicapped.

SELF ASSESSMENT EXERCISE 1

Highlight ways in which mathematics is useful in an individual's life

3.1.2 Mathematics in the Environment

Through the use of mathematical knowledge man has been able to extensively exploit and develop the physical environment, which has helped to make it habitable as it is today. For example, mathematical knowledge, aided with some knowledge of physics form the backbone for development in meteorological studies which in turn has made it possible to forecast weather and have a pre-knowledge of seasons. This in itself has been of tremendous benefits to farmers, industrialists and other professionals. Fakuade (1977) has highlighted that:

> "The exploitation of the earth's natural resources on the surface and underneath has been enhanced by the study and use of mathematics. The development of transportation networks, telephone net-work and net-work techniques as used in maximum flow, cheapest path algorithm hydraulic net-works and gas pipeline networks has been made possible through direct application of the processes of mathematics and mathematical knowledge."

Indeed, as you look around you, the evidence of mathematics is all over the environment.

3.1.3 Mathematics in Pure Science and Social Sciences

The developments of other science subjects owe so much to mathematics. Any attempt to study and understand science subjects will be difficult if not impossible if the fellow concerned is not mathematically sound. In fact the heart of any scientific theory is based on a series of mathematically deduced principles. For example, the trigonometric functions has direct application to all wave motions such as sound, light, radio, water waves etc.; hence anyone who understands trigonometric functions and their properties will not have any problems in the study of wave motions. In Schools today, students wishing to study science subjects must possess aptitude for mathematics because it is the basic instrument of science. For example, "the association between mathematics and physics is so close and frequent that without mathematics, there could hardly be any substantial physics in existence" Fakuade (1977).

A student wishing to study chemistry needs to be well versed in the use of four rules, decimals, percentages, ability to use logarithms, graphs, direct and inverse proportions, indices etc. At a higher level the knowledge of calculus will also be required. This again calls for an adequate knowledge of mathematics.

In a similar fashion, the study of biological sciences (agricultural and medical sciences inclusive) also require mathematical understanding especially the aspect of statistics, calculators and the use of computers for numerical calculations and data-analysis.

Mathematics has also deeply permeated the areas of social sciences. For example, it is almost impossible to make a successful study of economics or econometrics without an adequate knowledge of mathematics up to advanced level. Financial studies make use of mathematics; Insurance companies use mathematics to construct life-tables, premium tables and such like. Indeed mathematics is the queen and servant of all subjects.

3.1.4 Mathematics in Technology and Industries

It is a fact that Technological and Industrial development have voracious appetite for mathematics. The use of mathematics permeates every aspect of Engineering – whether in the aspect of research and design development or in its manufacturing and commercial activities. For example:

"In electrical engineering, the search for the problem, the study of the physical situation and the making of a mathematical model, the solution of the problem, generalization of the solution and interpretation of results all have recourse to use of mathematics" (Fakuade 1977).

Discussing the practical values of mathematics, Ogunsulire (1977) also highlighted some areas where mathematics has served as necessary tools such as:

> "The construction of bridges and sky scrappers, the harnessing of the power of water, coal, electricity and the atom; the effective employment of light, sound and radio, in illumination, communication, navigation and even in entertainment, the use of pulleys in lifting heavy weights and the advantageous employment of chemical knowledge in the design of materials, in the production of useful forms of oil and even in medicine…"

Russians have earned a great name, and have been hailed as the first nation to land on the moon, but let it be noted that the study and construction of rockets, which enabled them to do this, could not have been possible without sound knowledge of mathematics.
Indeed, the need and usage of mathematics in Technological achievement cannot be exhausted; and it is a truism that the better a mathematician an engineer is, the better an engineer he becomes.

3.2 Implication for Schools Mathematics Curriculum

The afore-going discussions have some implications for school mathematics curriculum in the areas of teaching, teacher production and curriculum design itself.

3.2.1 Teaching Mathematics for Technological Education

There is a general need to teach mathematics for the purpose of achieving technological development. It is not enough to present mathematics purely as an intellectual exercise, or worse still as a series of isolated tricks to be memorised. Rather it should be presented in such a way that learners would be able to see its values and usefulness. This can be done by teaching application of mathematics to solve everyday life-problems. This will help to achieve the followings:

Teaching application of mathematics to related everyday life situation and to other discipline and as a tool to solve problems will motivate

students to learn mathematics. Teachers need to know that majority of students don't learn mathematics for the pure love of it – but because they need and hope to apply it to something this is particularly true of technical, technological and engineering students.

Ironically, at the initial stage of their exposure to mathematics, many of them don't know why they are studying it, they don't know its use – so they feel highly disturbed about been forced to learn meaningless terms and jumbled figures.

Teachers should not just ask students to wait till some distant future before they know the use of what they are learning – Let them apply it to solve relevant problems at their specific level, this will not only enable them to know the use of mathematics, but also motivate them to learn it. It is not gain saying to say that a major problem of the dislike, negative attitude and poor performance in mathematics is due to lack of motivation, knowing the use of mathematics they are taught will help to motivate students.

Another well-known fact is that science subjects form the core for technological studies and mathematics is the backbone for all of them. An important implication of this therefore is that the teaching of mathematics and other science subjects should be presented with an inter-disciplinary approach. This will enable other subject and professional groups to benefit from one another. A common criticism by science teachers is that mathematics teachers do not place enough emphasis on the relevance of mathematics to other subjects. However, this may be due to the fact that mathematics teachers are either not knowledgeable in these other disciplines or they are not aware of their requirements.

3.2.2 Implication for Curriculum Design

There is also the implication for the design of mathematics curriculum. In designing a mathematics curriculum, the panel should include representation of people from disciplines that use mathematics not just educational administrators alone. Such a panel will include teachers of other disciplines, representatives from industries, Commerce, Agricultural Industries, Financial Institutions, Educational Researchers and Governmental Researchers and Governmental agencies, mathematicians and mathematics teachers. Such representations of users of mathematics will be able to discuss the mathematical requirements of one another, in order to know what to include in the mathematics syllabus and how it should be taught. For example, industries would

require not just a mathematician who can solve problems, but also one who can apply their mathematical knowledge effectively, and also able to formulate mathematical problems from given situations.

Approached in this way, it will go a long way to solve the problem of criticism on lack of relevance, which has always been levied on the school mathematics curriculum.

SELF-ASSESSMENT EXERCISE 2

In the light of the broad usefulness of mathematics, how should this affect its curriculum development?

4.0 CONCLUSION

Mathematics poses as an important and useful subject. Its usefulness touches every area of human endeavor; every individual uses mathematics, in one way or the other in daily interaction; it enters other subjects (both pure and social sciences) as an aid to enhance their understanding and development and it fosters economic and technological development of any nation. While it poses elegantly as a queen, it also bows down to serve them honorably. Being that important, paramount importance should be paid to its teaching and its curriculum development.

5.0 SUMMARY

This unit has examined mathematics as an important and useful subjects, it also highlights:

(i) Its usefulness in an individual life
(ii) Its evidence in the environment
(iii) How it enhances understanding and development of other subjects
(iv) Its impact on technological development
(v) The implication for its teaching and curriculum design.

ANSWERS TO SELF ASSESSMENT EXERCISES
(Note that these are not detailed Answers)

SELF ASSESSMENT EXERCISE I

The following are the highlights of how knowledge of mathematics is useful in an individual's life:

(i) It enables him to be able to handle daily money transactions

(ii) He will be able to read public notices or information that are presented in tabular form

(iii) It enables him to be able to budget his personal income accurately in a way that he is able to make ends meet.

(iv) He is able to calculate his purchases and be able to determine his correct change when he goers shopping.

(v) Professional/housewives will be able to carryout necessary measurements correctly in their relevant areas and need – e.g. carpenter, tailor, etc.

SELF ASSESSMENT EXERCISE 2

In the light of the broad usefulness of mathematics designing of its curriculum for schools should be given paramount importance. The panel to design such curriculum should include representatives from all users of mathematics, such as industries, financial institutions, governmental agencies, mathematicians and mathematics educators, etc.

They should discuss aspects of mathematics used by the various groups, to inform on what to include in the curriculum. Other subject specialist should indicate which aspect of mathematics they need or use; the period or time such should be taught and how it should be taught i.e. applying mathematics to relevant areas in which it is used during teaching.

All the above will help to remove the problem of lack of relevance. Learners also will be able to see application of mathematics in real life.

6.0 TUTOR MARKED ASSIGNMENT

1a. Discuss ways in which mathematics can aid technological development of a nation.

1b. what suggestion will you offer for the teaching of mathematics to enhance technological development.

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UNIT 2 PERTINENT ISSUES ON THE TEACHING AND LEARNING OF MATHEMATICS IN SECONDARY SCHOOLS.

CONTENTS

1.0 INTRODUCTION

As some one involved in mathematics – education – you should have known that Mathematics occupies an important position in the school curriculum; it will also not be news to you that it is a subject paramount for Industrial and Technological development of any nation; hence it's important for any developing country. However it is generally known that this subject is not popular among students. This poses a challenge to the teaching and learning of mathematics in the classroom. In this unit you will be exposed to some pertinent issues in the teaching and learning of mathematics.

2.0 OBJECTIVES

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

i Explain how parental attitudes affect their children's achievement in mathematics.

ii. Explain how teachers' attitude affect their students' achievement in mathematics.

iii. Relate how quantity and quality of teachers affect the learning of mathematics.

iv. Discuss how pre-service and In-service Training of Teachers affect the learning of mathematics.

Explain how textbooks and other learning materials affect the teaching and learning of mathematics.

Explain how other factors such as: demand for mathematical learning; the structure of mathematics and over population of classrooms affect the teaching and learning of mathematics.

3.0 MAIN CONTENT

3.1 Mathematics, an Important but Dreaded Subject

The importance of mathematics as a subject that is basic to all scientific and technological development is of a universal acceptance to all in the field of education.

With such a universal acceptance of mathematics as a key subject for progress and development, you too will agree that it is a subject of distaste to many students. Not only is it distasteful to them, they also both dread and perform poorly in it, the truth of this has been confirmed by a number of studies. For example, Osibodu (1977 in a study noted a regular high rate of failure at the school certificate level. It is not uncommon to find students who wished to pursue Engineering, Scientific or technological courses of studies unable to do so because they lack the minimum requirement in mathematics that will qualify them to pursue such courses. Definitely, there are problems in the learning and teaching of mathematics in our classrooms today.

This is an issue of concern to all in education industry generally but particularly to those in mathematics education.

Generally, the consistent poor performance in the subject has been attributed to such factors as negative attitudes of students and teachers to mathematics, lack of motivation in teachers; non-availability of instructional aids et cetera. Some of these factors are examined below.

3.1.1 Factors or Problems Relating To Attitudes

It is widely acknowledged that students' performance in mathematics is generally poor. This has been evidenced both by research (e.g. Osibodu 1977). and classroom experiences, even, the West African Examination Council's record for 1978 revealed that the worst results were in mathematics (Ojadi 1981).

However, when talking about poor performance, it is necessary to take a look at students' attitude towards the subject. For one thing, the poor performance in mathematics may be caused by negative attitudes towards it as inability to do mathematics and not liking it seem to go together. **Neale, (1969)** found out that attitude and achievement have a reciprocal effect in their relationship in that attitude affects achievement and achievement affects attitude. Hence in this section you will be taken through factors relating to attitudes and achievement in mathematics.

3.1.2 Parental Attitude and Students Achievement in Mathematics

It is a matter of fact that student's attitude towards mathematics is not solely developed at school, but the home background also contributes to the student's performance and attitudes in mathematics. This can happen through any of the following:

(i) Parental encouragement or discouragement
(ii) What parents expect their child's performance to be?
(iii) Parent's own attitude towards the subject.

Various studies have borne evidence to these facts, for example, in a survey by Ale (1984); some students categorically stated that their parents discouraged them by saying mathematics is not an easy subject for their family. Also **Poffenberger and Norton (1959)** found that students attitude towards mathematics were related to how they rated their father's attitude towards mathematics, as well as the level of achievement which their parents expected of them.

These findings show that there is a need for parents to help their children through their own positive attitude and high expectation from them in mathematics.

3.1.3 Teachers Attitude and Achievement in Mathematics

The influence of a teacher's attitude toward any subject, (but particularly mathematics) on that of his students cannot be over-emphasized. According to Wiseman (1970)…
"Teacher attitude is one of the most powerful forces… affecting pupil's progress".

Banks (1964) suggested that:

> "Teacher's attitude and effectiveness in mathematics may be the prime determinants of students' attitudes and performance in the subject"

These are basic facts; for if a teacher himself fears and dislikes mathematics if he does not feel comfortable about teaching it, if all he can do is a rote manipulation of problems, instead of teaching his students to understand, he cannot but transmit, this negative mathematical traits to his students. It is therefore necessary for mathematics teacher to have a positive attitude towards mathematics in order to help his students do the same.

SELF ASSESSMENT EXERCISE 1

(a) State the relationship between attitude and achievement in mathematics.
(b) In what ways can parents' attitude towards mathematics affect the child's performance in mathematics?

3.2 Teachers and Teaching Factors`1

As you would have known, the role of teachers in any educational enterprise cannot be brushed aside. According to **Ukeje (1974)**…

Teachers are the hubs of any educational system upon their number, their quality and devotion depend the success of any educational system". While this is true of all disciplines, it is particularly true of mathematics as a discipline. The teacher factor in the teaching and learning of mathematics shall be examined next.

3.2.1 The Quantity and Quality of Mathematic Teachers

A major problem facing the teaching and learning of mathematics today is lack of enough teachers to handle the subject particularly at the secondary level. This is even made worse as the number of schools increases, as well as number of pupils in schools. Apart from this there is also a demand for mathematicians in Industrial and Commercial set ups. This shortage in the number of mathematics teachers has led to borrowing teachers who are specialists in other disciplines like chemistry, physics, economics, engineering etc. to teach mathematics. In many cases such borrowed teachers are not professional teachers i.e. they are not trained teachers.

Hence they lack both the adequate knowledge (since they are not mathematics specialists) and the teaching methods required to teach mathematics effectively.

Usually too, such teachers avoid the teaching of topics which they find difficult to handle. In essence, it means that short supply of qualified teachers leads to mathematics teaching been handled by incompetent hands who in turn can only produce poorly bred mathematics students. The student therefore becomes a victim of poor teaching.

This trend confirms the assertion by **Fakuade (1973)** that "A shortage of suitably qualified teaching staff will result in poor teaching which invariably will result in a production of another generation of poor students".

The few qualified mathematics teachers are also beset by a number of problems. In some cases such teachers are not fully available for the teaching of mathematics alone. This is because; they may also be required to teach certain other subjects like physics another subject in which there is usually shortage of teachers. Note that in many cases teachers of mathematics are usually also qualified to teach physics too. Such teachers are usually bogged down by many periods of teaching for which they are not compensated. On the other hand, are the problems of teachers who lack devotion to their duties?

They do not show interest on how they can be effective in their teaching. They do not plan their lessons, and when they do it is usually for the purpose of inspection; they do not care about using appropriate methods of teaching, nor do they bother to use teaching aids. Many times they don't aspire to cover the mathematics syllabus specified by the curriculum.

Because of the ways these set of teachers handle the subjects, many students develop negative attitude towards mathematics, in addition to performing poorly in it. Surely you too can add to this list of experiences.

3.2.2 Pre-Service and In-Service Training of Mathematics Teachers

If mathematics teaching is to be effective, the pre-service training of teachers must be very sound, while they also need to be exposed to in-service training at regular intervals. Where teacher preparation is in adequate it will lead to teaching failure in the classroom; this is an area that needs to be improved upon. Fakuade (1977) pointed out that "Education authorities at all levels – national, state and local, have not paid adequate attention to the training of teachers of science and mathematics".

In this regards, exposure to mathematical contents seems to be in adequate; the aspect of methodology has always received less attention. The idea is that the contents required more rigour to pass, so it is given greater attention, while the methodology, which is deemed easier to pass receive less attention.

Mathematics methodology should be given more time than is being done presently. This is to allow time for student teachers to be taken through the syllabus of secondary/primary levels where they will teach. They need to be thoroughly familiar with the contents be able to handle all the topics with ease, as well as knowing the best strategies to be used in handling the various topics in the syllabus. All these should be done before they go out for practical teaching. Such detailed preparation is not being done at the moment, and it is not uncommon to find trained teachers not having understanding of the topics he is to teach very well.

This usually means that he has to learn them first usually under a tense atmosphere, before going to teach such topics. With lack confidence of the subject matter; he may try to dodge questions from students while teaching. On the other hand, if the teacher cannot discipline himself to learn those topics, he avoids teaching them by omitting them in the syllabus. Definitely students under such teachers cannot be helped to either enjoy mathematics or perform well in it.

Another aspect of teacher preparation is the need for in-service training of mathematics teachers; this will enable them to keep abreast of development in teaching strategies, and motivational devices towards helping students to learn mathematics. At present, this aspect is not being taking seriously and education authorities need to work towards encouraging teachers to go for in-service training from time to time.

SELF ASSESSMENT EXERCISE 2

How does lack of trained teachers or their inadequacy affect the teaching and learning of mathematics?

3.3 Textbooks and Other Learning Materials

The mathematics textbook is a basic tool in the teaching and learning of mathematics. In most cases, it is the main resource material, being used as a guide in the teaching programmes. Since this is the case, it is important that mathematics text be of a good standard that can enhance the teaching and learning of mathematics. Thank God that in recent years, mathematics textbooks written by indigenous authors are now available unlike in the past when foreign authored textbooks dominated the market.

This is a development in the right direction; however a number of these textbooks are not accompanied by Teachers guide. Some of them are not presented in such a way that students can read and understand by themselves; sometimes too the language used is not simplified enough nor are the sequences easy for students to follow. It is important that students should be able to read and understand mathematical concepts even when the teacher is not around.

Frequent changes of textbooks recommended by school authorities also present its own problems. Apart from the fact that different authors have their own style of writing which places different demand on the logical thought of students; it also places financial burden on parents who have to buy different textbooks at short intervals because of such changes.

Apart from textbooks, mathematics lesson needs to be enriched with teaching aids like concrete materials, pictures, demonstrations etc. to help student's comprehension. Unfortunately, such are usually not available either due to teacher's indifference or due to lack of fund to provide for such environment. This further complicates things for students who have always complained that mathematics is too abstract.

3.4 Other Factors

A number of other factors, which present problems in the teaching and learning of mathematics, include the following:

3.4.1 Cognitive Demand for Mathematics Learning

By its nature, mathematics requires that students be able to think through and get a lot to practice in solving problems, this calls for concentration and involves spending time on the part of the students. Many students are not prepared to make this sacrifice so they are easily discouraged with learning mathematics.

3.4.2 The Structure of Mathematics

The structure of mathematics is such that the concepts to be learnt are built one on the other and are interdependent. Hence the understanding of concepts at one level depends on the completion and understanding of concepts on topics at the lower level.

Therefore, when a syllabus at lower level (say J.S.S.) is not completed, or not properly understood by students, it will hinder the understanding of what is to be learnt at a higher level e.g. S.S. level. A notable occurrence in schools however is that in many cases, mathematics syllabus of a particular class are not completed, either due to lack of time or through a teacher deliberately avoiding some topics that he himself is not comfortable with. In addition, many of the topics covered are not properly understood by learners. This creates problems for them at the next level of learning.

3.4.3 Over-Population of Classrooms

Mathematical learning and teaching requires giving individual attention to learners, as one learner's problems to comprehend may be different to another. In the past such assistance could easily be offered because classroom population was sizable, usually between 25 and 30 students in a class. Since the launching of Universal Primary Education (UPE) in the seventies, however, school enrolments soared up, and classroom population doubled or tripled. With about 60 to 70 students in a classroom, it becomes unpracticable to offer individual assistance to students, and they have to make do with what they can assimilate during the general teaching.

4.0 CONCLUSION

Mathematics as a subject has been acclaimed to be very important both to the understanding of other subjects and to the economic and technological development of any nation. Ironically, it is a subject that is most dreaded by many students and in which most of them perform poorly. A number of factors are responsible for this.

Attention need to be paid to such factors by all concerned with education with a view to breaking the barrier militating against both student interest and their satisfactory performance in it. This in turn will help to move the country forward.

5.0 SUMMARY

In this unit, the major problems confronting the teaching and learning of mathematics has been highlighted. These include:

(i) Problems relating to attitudes – parental and teacher attitudes as they affect achievement in mathematics.
(ii) The quantity and quality of mathematics teachers; pre-service and in-service training of mathematics teachers.
(iii) Text books and other learning equipment and
(iv) Other factors which include
- the demand of mathematics
- the structure of mathematics and problems brought about by over-population in the classrooms.

ANSWERS TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

(a) Attitude and achievement are related in such a way that they have a reciprocal effect on each other, i.e. attitude affects achievement and achievement affect attitude.
(b) Parental attitude towards mathematics can affect the child's performance in mathematics in the following ways.

(i) Parental expectation i.e. what parents expect the child's performance to be will affect how the child actually performs
(ii) Whether a child is encouraged or discouraged towards learning mathematics.
(iii) The attitude of parents themselves towards mathematics.

SELF ASSESSEMENT 2

Lack of trained teachers or their inadequacy affects the teaching and learning of mathematics in the following ways:

(i) Teachers who are not specialist in mathematics are some times borrowed to teach mathematics.
(ii) They may lack adequate knowledge of mathematics, and so may not have much to offer the students.
(iii) They lack the methodology of teaching mathematics.
(iv) Some of them avoid the teaching of difficult topics in the syllabus, this create problems for students in their future learning since understanding of one concept may depend on the understanding of another one learnt before it.
(v) All these usually result in breeding of students who are weak in understanding mathematics.

6.0 TUTOR MARKED ASSIGNMENT

1. Discuss how the following affect the teaching and learning of mathematics.
   (i) Pre-service and In-service training of mathematics teachers.
   (ii) Quantity and Quality of mathematics teachers.

2. How may the following create problems to mathematical teaching and learning in the classroom?
   (i) Lack of good textbooks and other learning materials.
   (ii) The structure of mathematics
   (iii) Over population of classrooms.

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UNIT 3 THE GOALS AND OBJECTIVES OF TEACHING MATHEMATICS AT THE PRIMARY AND SECONDARY LEVELS

CONTENTS

1.0 INTRODUCTION

In this unit, you will be exposed to the goals and objectives of teaching mathematics at the primary and secondary schools. It is important that every teacher understands the reasons why the subject he teaches is included in the curriculum. This will enable him teach in the right direction towards the achievement of the objectives. This among other things is the reason why the unit has significance for you as a teacher.
Enjoy your reading as you go through the unit.

2.0 OBJECTIVES

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

(i) State the purposes of listing subjects in the school curriculum
(ii) Highlight the importance of stating objectives
(iii) Enumerate factors that influence selection of objectives
(iv) State the objectives of teaching mathematics at the primary and secondary levels

(v) Relate how mathematics can help to achieve the National goals of education.

3.0 MAIN CONTENT

3.1 The Purpose of Listing Subject in the School Curriculum

When a subject of study is included in a school curriculum, there is a desirable contribution it is expected to make; both to the society for which the curriculum is prepared and to the learner's end product behavior. It is not just for the purpose that learners should pass the subject. The above implies that there are goals or objectives for any such subject listed in the curriculum including mathematics.

This Nation has objectives for the teaching of mathematics in all levels of her schools. However the concern of this unit is to look at the objectives of teaching mathematics at the primary and secondary levels.

By way of simple definition, subject curriculum objective refers to the specific statements of the purpose of teaching the particular subject. Usually when an educational programme is being planned, the objectives should first be clearly defined before going on to identify the contents of the programme.

3.2 The Importance of Stating Objectives

It is important to state the objectives for the following reasons:

(i) Statement of objectives will guide in determining the task, or the contents (in our case – the mathematical contents) needed to accomplish the objectives

(ii) It will guide the teacher to channel his teaching in the right direction

(iii) It will guide in evaluating the progress of the learners that are undertaking the programme.

SELF ASSESSMENT EXERCISE 1

Why is it important to state objectives when planning an educational programme?

3.3 Factors That Influence the Selection of Educational Objectives

Selection of goals and objectives for a curriculum design is never done without considering the needs, problems and aspiration of the people or the society for whom it is being designed. and questions such as: what are the major needs and problems of this society at the present time are usually asked. With respect to mathematics the question asked are which of the problems or needs can mathematics be used to address or solved and in what ways can mathematics be taught to address those needs and problems?

Also, pertaining to the individuals in the society that will go through the course i.e. the learners, the questions asked are: What are the needs of the learners? In what ways can mathematics help to meet the various needs of the learners? By exposing the learner to the mathematics curriculum of the schools, can he make a successful living; and become useful to himself and to the nation at large?

As a mathematics educator and a teacher of mathematics, you need to be conversant with the objectives of teaching mathematics at the various levels of the Nigerian educational system, and particularly at the primary and secondary levels. This will assist you to channel your mathematical teachings in the right direction and will also enable you to improve your skill in the teaching of the subject.

In the following sections, the objectives of teaching mathematics in the Nigerian primary and secondary levels of education shall be discussed. Efforts shall also be made to spell out how the knowledge of the subject can help in achieving these objectives.

SELF ASSESSMENT EXERCISE 2

What are the factors that influence the selection of Educational objectives?

3.4 Objectives of Mathematics education at the primary level

In practice, the national objectives of education is usually first identified; then the specific objectives of a curriculum will then be identified from it. The national objectives of primary education in Nigeria as contained in the National policy on Education of 1998 as follows:

3.4.1 General Objectives of Primary Education

(a) The inculcation of permanent literacy and numeracy, and the ability to communicate effectively.
(b) The laying of a sound basis for scientific and reflective thinking;

(c) Citizenship education as a basis for effective participation in, and contribution to the life of the society.
(d) Character and moral training, and the development of sound attitudes
(e) Developing in the child the ability to adapt to his changing environment
(f) Giving the child opportunities for developing manipulative skills that will enable him to function effectively in the society within the limits of his capacity;
(g) Providing basis for further educational advancement, including preparation for trades and crafts of the locality.

From the above general objectives, Abimbade A. (1995) derived a list of objectives of mathematics teaching in the primary school; they include the following:

(i) To provide the child with the necessary basic skills in innumeracy
(ii) To expose the child to ways of applying these skills to solve problems.
(iii) To provide the child with the basic manipulation skills useful in ordinary life
(iv) To provide the child with the basic skills in logical thinking.
(v) To introduce the child to the basic concepts of spatial relationship and
(vi) To introduce the child to the basic skills of record keeping and all aspects of accounting.

3.4 The General Objectives of Secondary Education

The objectives of secondary schools education are stated in section 4, item 18, of the National Policy of Education as follows:

(a) to provide an increasing number of primary school pupils with the opportunity for education of a higher quality, irrespective of sex, or social, religious and ethnic background.
(b) To diversify its curriculum to cater for the differences in talents, opportunities and roles possessed by or open to students after their secondary school course.
(c) To equip students to live effectively in our modern age of science and technology
(d) To develop and project Nigerian culture, art and language as well as the world's cultural heritage.
(e) To raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of

labour and appreciate those values specified under our broad national aims and live as good citizens

(f) To foster Nigerian unity with an emphasis on the common ties that unites us in our diversity.

(g) To inspire its students with a desire for achievement and self-improvement both at school and in later life.

In order to achieve the above stated aims; educational experts put together subject curricula in different subjects including that of mathematics (General and further mathematics) at both Junior and Senior Secondary School levels.

As stated earlier, subject curriculum objectives refers to the statements of the purpose of teaching that particular subject. Note that the statements of objectives should first and foremost be done whenever a subject curriculum is being designed.

In line with the above procedure, the Mathematics Association of Nigeria (MAN) at the Benin conference of 1977 derived the following objectives of teaching mathematics at the secondary level:

(1) To generate interest in mathematics and to provide a solid foundation for everyday living
(2) To develop computational skills
(3) To foster the desire and ability to be accurate to a degree relevant to the problems at hand.
(4) To develop precise, logical and abstract thinking
(5) To develop the ability to recognize problems and to solve them with related mathematical knowledge.
(6) To provide necessary mathematical background for further education and
(7) To stimulate and encourage creativity

On page 16 of the policy, it is further stated that the broad aim of secondary education should be:

(i) Preparation for useful living within the society and
(ii) Preparation for higher education.

Indeed, these stated broad aims can be regarded as the summary for educational goals at both primary and secondary levels of education. The first of the two aims caters for the interest of those who cannot go on to tertiary institution, while the second caters for those who have opportunity to proceed on the educational ladder to higher studies. How then can mathematics help in achieving these two broad aims of

education? The relevance of mathematics in achieving these two aims shall be examined in turns:

3.5 The Role of Mathematics in the Broad Educational Goals

(i) Preparation of learners for useful living

This goal also tallies with the utilitarian goal of mathematics; and indeed mathematics is a subject of immense utility to living. The basic mathematical concepts to which children are exposed early in school are such that will be useful in any adult life. This includes the concept of addition, subtraction, multiplication, and division, weighing, measuring, selling and buying. These basic mathematical concepts have tremendous practical usefulness in life. For example everyone needs to make use of numbers in one way or the other; will need to measure in one form or the other and should be able to read and interpret elementary statistical information. In specific terms, knowledge in these basic mathematical processes will enable an individual;

(i) To accurately budget his earnings

(ii) To calculate his purchases correctly when he goes shopping, and be able to determine his correct change. i.e. he should be able to handle money transaction in buying and selling processes.

(iii) to use numbers in different situations such as in measurement of length, area, volume, time, skeptic for instance in measuring amount of materials needed for e.g. bed sheet in tailoring or as in carpentry to be able to calculate amount of wood needed to make e.g. book shelves or even to be able to calculate amount of raw food to purchase for the family etc.

Mathematics as a subject is very useful in inculcating the spirit of economy in learners, thereby checking economic waste in everyday life. The concepts of estimation and approximation will go a long way to do this; for instance, a housewife who is able to correctly estimate amount of materials needed for children clothing; or a carpenter who is able to estimate amount of roofing irons needed to roof a building etc will help to check wastage of resources.

Mathematics also teaches economy of time, money, speech and even thought for instance, a student who learns to distribute time allocated in examination over the questions to be answered, is being economical in use of time during examination; or an individual who is able to budget his earning will be economical in his spending. Symbols and notations used in expressing mathematical ideas makes for economy in language and thought, and all these will develop the art of economical living

(which in turn is a necessary condition for a happy life) which is a by-product of mathematical learning.

Mathematical languages used in presenting mathematical ideas are usually concise, or in form of symbolic representation and well-defined terms which all make for precision in communication. The study of mathematics will enable its student develop the habit of clarity, brevity, accuracy and precision in their expression. In study of logics, validity of conclusions usually depends on the validity and consistency of the assumptions and definitions; this in turn will enable learners to develop ability to reason logically; logical reasoning in turn will generate a spirit of understanding and will help to eliminate civil riots and conflicts in our society.

The study of mathematics requires an individual to personally sit at it frequently and figuring the ideas out alone – this will develop the habit of self-education in the learner. Problem solving is inherent in the study of mathematics, and success in problem-solving efforts makes the learner become more confident – hence learners will develop the habit of self-confidence as they study the subject. Mathematics demands hard work from its learners, hence the study of this subject will help to breed hardworking citizen that are very much needed in this country today. Put together, these latest points go to show that mathematics has the potential of character building in its learners, certainly then, the study of mathematics as a subject has much to contribute in preparing an individual for a useful living in the society.

(ii) Preparation for Higher Education

Generally speaking, the foundation of mathematical knowledge laid in the primary school should adequately equip learners for secondary school mathematics. Similarly any student wishing to proceed to higher institution today must be well grounded in secondary school mathematics. This is because, in the words of Mbakwe Samuel, an ex-Governor of Imo State "I cannot think of anything for which the assistance of the discipline (i.e. mathematics) is not sought." More specifically, however, anyone who wants to pursue any science subjects and certain social science subjects must be well equipped with secondary school mathematics. For example, consider the case of Physics; it has been noted that no other subject is as close to mathematics as physics hence anyone who wishes to study physics in higher institution must have a good grade in mathematics otherwise he will not be able to study physics with confidence. A good knowledge of mathematics is also required for the study of chemistry; particularly a learner may not be able to make a head way in both organic and physical

chemistry without an adequate basic knowledge of calculus and mathematical analysis.

It has also become necessary to be knowledgeable in mathematics to be able to forge ahead in the study of Biology, especially for the study of Biophysics and Biochemistry which are branches of Biology.

Without exaggeration, mathematics is highly essential for the study of Engineering. In fact, it is considered to be the foundation of engineering; hence a good grade in mathematics is usually required for admission into engineering courses. Aspects of engineering studies include estimating, designing, surveying, leveling, construction etc. and in all these, application of mathematics is usually called for.

Application of mathematics is also called for in the study of agriculture where study activities includes measuring area of land, or just land measurement, calculating average investment or expenditure, cost of labour, manure rate, seed rate etc. All these cannot be well executed without a good background of secondary school mathematics.

Knowledge of mathematics is also essential to study many social science subjects. For example the use of mathematical methods to study and practice economics is on the increase such that it is no longer possible today to study economics without a good background in mathematics. The same is becoming true of Political Science, Psychology, Sociology, Business Administration, Accounting and Banking and Finance. Hence for anyone to be able to study any of these subjects with confidence a good background of secondary school mathematics is needed.

From the foregoing, it is quite clear that mathematics at both primary and secondary levels have relevance to achieving the Nigerian educational goals.

4.0 CONCLUSION

Mathematics as a subject in the School Curriculum has contributions to make towards achieving the national goals and objectives of education in Nigerian. It has roles to play in the preparation of individual for useful living in the society, and/or in preparing him for higher education. However, attention should be paid to adequate preparation, and motivation of teachers who will implement the mathematics curriculum. For, as noted by Lassa (1984) “no matter how good the mathematics is, if you do not have well qualified, trained and motivated teachers, we may not achieve our goal”

5.0 SUMMARY

The following are the highlights of the issues treated in this unit:

(i) The purpose of listing subjects in the school curriculum
(ii) The importance of stating objectives
(iii) Factors that influence selection of objectives
(iv) Objectives of teaching mathematics at the primary and secondary levels
(v) The role of mathematics in the broad aims of educational objectives which includes
  (a) Preparation of learners for useful living
  (b) Preparation of learners for higher education

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

Why it is important to state objectives when planning educational programmes.

It is important to state the objectives for the following reasons

(i) Statement of objectives will guide in determining the task or the contents needed to accomplish the objectives.
(ii) It will guide the teacher to channel his teaching in the right direction.
(iii) It will guide in educating the progress of the learners that are undertaking the programme.

SELF ASSESMENT EXERCISE 2

Factors that influence the selection of Educational objectives.

Selection of goals and objectives for a curriculum design is never done without considering the needs, problem and aspiration of the people or the society for whom it is being designed.

Questions such as: what are the major needs and problems of this society at the present time are usually asked?

Also, pertaining to the individuals in the society that will go through the course i.e. learners, the question asked with respect to mathematics, is which of the problems or needs can mathematics be used to address or

solve? Also, in what ways can mathematics be taught to be able to address those needs and problems?

6.0 TUTOR MARKED ASSIGNMENT

(1) The whole aims of Educational Objective can be summarised under the two Primary and Secondary educational levels Highlight:
   (a) State the summarised two objectives.
   (b) Discuss ways in which mathematics can help to achieve those two summarised aims.

7.0 REFERENCES/FURTHER READINGS

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UNIT 4 PLANNING TEACHING ACTIVITIES

CONTENTS

1.0 INTRODUCTION

In this unit, you shall be exposed to how to plan teaching activities through the writing of the Scheme of Work, the Unit Plan and the daily Lesson plan. They are so important to teaching activities that they cannot be simply brushed aside. Hence, read with an open mind and enjoy your reading.

2.0 OBJECTIVES

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

(i) Enumerate thedifferent types of planning for teaching activities
(ii) Relate the meaning and importance of scheme of work, unit plan and daily lesson plan.
(iii) List the main features of a unit plan and write a standard unit plan.
(iv) list the main features of daily lesson plan, and write a good lesson plan.

3.0 MAIN CONTENT

3.1 The Need to Plan

The importance of planning in any human endeavor can never be over-emphasized. If success is to be achieved in any enterprise undertaken, planning is essential. There is truth in the saying that to fail to plan is tantamount to planning to fail. On the other hand well planned is half finished This is equally true in the teaching and learning enterprise, just as it is in other professions; For example, a lawyer will plan well ahead before he goes to court to defend; an engineer would have prepared a well-planned course of action before carrying out his work, in the same way, a mathematics teacher who does not want to fail must plan a well-defined course of action for carrying out his teaching assignment. This includes course planning or scheme of work; Unit planning, daily lesson plannings and even plans for evaluation. This unit will expose you to how to go about such plannings.

3.2 Types of Planning for Teaching Activities

There are different types and stages of academic or instructional planning. The first stage is that of Curriculum development, this is usually done by a team of Curriculum experts for a particular programme or course. When this is handed down, further work of breaking it down into learning units is done by the various authorities concerned.

When a curriculum is broken down into list of topics that students should study in a particular subject in the particular course or programme, this is called the syllabus.

This may further be broken down into yearly plan. This is usually done by the various educational controlling bodies for schools under her supervision, the Local Education Authorities for Schools in her Local Government or the Ministry of Education for Schools under her supervision.

Following this, the next stage is to break the topics further and organize them into Scheme of Work, Unit Plans, and Daily lesson plans. This is essentially the work of the teachers, and it is a stage where their professional expertise is challenged.

3.3 The Scheme of Work

At this stage, the mathematical topics for the year will be broken down into termly plans i.e. each year's work will be broken into three to correspond to the three terms in a year. Each term's works will further be broken into the number of weeks in the term. This represents the amount of work to be covered in each of the term.

If well prepared, the Scheme of Work has the following advantages:

(i) It helps the Teacher to arrange the term's work in logical sequence.
(ii) It enables the Teacher to distribute the term's and hence the year's work evenly, thus making him avoid unnecessary rush and repetition.
(iii) This represents a plan of action that will enable him to plan ahead the suitable materials he will need and make necessary preparation before each topic is due for teaching.
(iv) If the Teacher is transferred, a well prepared Scheme of Work will enable the in-coming Teacher to know what has been done and where he is to begin his own work.

SELF ASSESSMENT EXERCISE I

What do you understand by a Scheme of Work?
What are four advantages of planning the Scheme of Work?

3.4 The Unit Plan

The Unit Plan is the mid-way stage between the Scheme of Work and daily Lesson plan. It is made up of a set of related learning experiences, obtained from the breakdown of a mathematical theme, concept or topic into units of different lessons. The lessons are then organized and Grouped together for teaching purposes. A unit plan lessons may last for one week or more.

3.4.1 Format of a Unit Plan

Essentially, a Unit Plan must contain the following:

(1) The subject
(2) The topic of the unit
(3) The class for which the unit is being planned
(4) Objectives of the unit
(5) Entry behavior

This refers to the previous knowledge that learners have which may be useful in the new concept to be learnt. It helps the teacher to know where to begin the new concept with learners.

(6) Delineating the area of the unit to be covered in each lesson. A guideline to the teacher is to teach one concept at a time or teach to achieve one objective in one lesson or the amount of work that can be covered in one class period of 35 to 40 minutes.
(7) Identification of methods and teaching aids to use; this makes it easy to plan for the daily lessons.

3.4.2 Sample Unit Plan

Subject: Mathematics
Class: Primary 5
Unit Title: Percentages
Duration: 2 weeks
Sub-unit Titles: (1) Meaning of percentage
(2) Addition and subtraction of percentage
(3) Changing percentages to simple fraction
(4) Changing fractions to percentages
(5) Finding percentages of numbers and quantities
(6) Expressing one quantity as a percentage of the other

Entry Behavior

(i) The learners have studied fractions;
(ii) They can reduce fractions to their lowest terms
(iii) They have also studied decimals

Unit Objectives: - At the end of the Unit, the learners should be able to

(1) Explain the meaning of percentage
(2) Add and Subtract in percentages
(3) Change percentages to fractions and vice-versa.
(4) Find percentages of numbers and quantities.
(5) Express one quantity as a percentage of the other

Contents of the Unit

(1) Meaning of percentage
– Another type of fraction always having 100 as a denominator.
– Using sections of 100-square chart to represent percentages

(2) Comparing fractions, decimals and percentages

– Changing percentages to simple fractions
– Changing fractions to percentages
– Changing decimals to percentages
– Changing percentages to decimal
– Building a table of equivalents in fractions, decimals and percentages e.g.

Fractions	Decimals	Percentages
1	1	100%
½	.5	50%
¾	.75	75%
¼	.25	25% etc

(3) Addition and Subtraction of Percentages:

E.g. If 55% of learners in a class are boys, what percentage are girls?
– In a Census results of a village, 25% are children, 45% are women, and what percentage are men?

(4) Finding percentages of numbers and quantities

- Percentages of numbers e.g. 40% of 200
- Percentages of money, weight and length, measures etc.

E.g. 25% of N20:00
12½% of 2Kg
50% of 30m

- Simple problems involving percentages e.g. attendance of school, church or mosque; percentage of area occupied by a building etc.

(5) Expressing one quantity as a percentage of the other

e.g. – What percentage is 45 of 60 or what percentage of 60 is 45?
- What percentage of 2km is 500m.?

Methods and activities

Using appropriate questions, and relevant explanation, the teacher should lead learners to understand the basics of percentages. He should guide the class discussion in the right direction towards the achievement of the objectives on the concept of percentages

Instructional Materials

Large copy of 100-square chart; and smaller size copies for learners to use in their groups, and for individual learners (N.B. – Learners can be guided to make individual copies.)

Evaluation

The Unit Learners should be able to solve the following problems and other similar ones.

(1) Using 100-squared charts represent the following numbers on them: use different colours or shading for each number

(i) $\frac{11}{100}$ (ii) $\frac{15}{100}$ (iii) $\frac{1}{10}$ (iv) 0.05 (v) 0.02

(3) Copy and Complete the following table

Fractions In its Lowest terms		**Fraction with Denominator of 100**	**Decimals**	**Percentages**
Example 3/5		$\frac{60}{100}$	0.60	60%
1	$\frac{5}{10}$	$\frac{50}{100}$		
2	$\frac{3}{20}$		0.15	
3	$\frac{2}{25}$	$\frac{8}{100}$		
4	$\frac{4}{5}$	$\frac{80}{100}$		
5	$\frac{7}{10}$		0.7	

(4) Find the values of the following:-

(i) 5% of 100 (ii) 35% of 80

(iii) A farmer has 300 fowls and sell 60% of them, how many does he have left?

(5) The area of a school compound is 5 hectares, 30% of this is occupied by buildings, how many hectares are not built upon.

SELF ASSESSMENT EXERCISE 2

(i) What is the meaning of a Unit Plan?

(ii) Write down the format (or features) of a Unit Plan

3.5 The Lesson Plan

This is the most important and challenging aspect of the planning for the teacher. This is because, with a well-prepared lesson note, the teacher can go into the teaching activities with a sense of security – having prepared the contents, the strategy, the instructional materials and the evaluation of the lesson. There are different models of lesson plans, but each of them must contain some basic elements. The following are essential features of a lesson plan.

(i) The subject
(ii) The topic to teach
(iii) The class must be indicated
(iv) The duration of the lesson
(v) Entry behavior of the learners
(vi) Instructional objectives must be stated
(vii) The instructional aids to use if any
(viii) **The Contents**: It is important that the Teacher master the contents he is going to teach for he cannot teach effectively if he himself is not familiar or master the contents.
In developing the lesson plans, he should ensure that the contents is sequentially developed, and should indicate both the teacher and the learner's activities in the course of the lesson.
(ix) **Evaluation:** The lesson plan should include the question that will be used to evaluation the lesson.

3.5.1 Example of a Lesson Plan

Subject: - Mathematics
Topic: - Percentages
Class: - Primary 5
Duration: - 35 Minutes

Instructional Objectives: -At the end of the lesson, learners should be able to

(i)Explain the meaning of a percentage
(ii)Represent percentage fraction on a 100-square chart.
(iii)Rewrite fractions and decimals in percentages

Entry Behavior: - The learners have studied fractions, and decimals
Instructional Aids: - (i) A Large 100-square chart for the Teacher to hang on the board where all learners can see it.

Smaller size of 100-square chart for the learners. (These could be jointly produced by the teacher and learners before the lesson).

Procedure

Step I:- Meaning of Percentage

Explain to the learners that percentage is another type of fractions. Just like fraction and decimals, it is used to represent parts of a whole; however, percentage always has 100 as its denominator.

For example: 2/100 means 2 out of 100, and is called 2 percent. 2 percent is written as 2 p.c. for short or as 2%

Now ask the class – have you come across numbers written in percent before – Let them respond:

They may likely recall that examination marks are usually given in percentages. You can listen to other similar responses e.g. bank also gives interest on savings in percentages e.g. 4% or 5%. This is to let them know the use of percentage in real life.

Step II: - Hang the Large size 100-square chart on the board.

Ask them to make a quick count of the squares – to be assured it is 100.

(i) Next shade two of the squares in say blue colour then ask them
How many squares are shaded:-
Their response:- two
How many squares are there altogether?
One hundred.
So we have shaded 'two out of hundred'
This can be written as 2/100 in fraction
It can be written as 0.02 in decimal
And it can be written as 2% in percentage

(iii) Shade another set of squares in another colors, say 15 squares in red
Then ask the class
How many squares are now shaded out of hundred
Answer 15 out of hundred
How can I write it as a fraction?
Accept correct answer of 15/100 as a fraction
In a similar way ask for other representations
i.e. = 0.15 as decimal
= 15% as percentage

Step III:- Shade the following one at a time and as you shade let them write the shaded portions in fractions, decimals and percentages.

(i) Shade 9, 12, and 22 respectively.

Go round to see how each learner fares, and render help where needed

Step IV: - Evaluation

Distribute the 100-square charts to each learner and let them attempt the following exercises.

1. On your chart, shade the following number of squares;
   (i) 3 (ii) 20 (iii) 18 (iv) 25
   Then write them down as
   (i) Fractions (ii) Decimals (iii) Percentages
2. Rewrite the following numbers as percentages
   (a) (i) $\frac{16}{100}$ (ii) $\frac{63}{100}$ (iii) $\frac{4}{10}$ (iv) $\frac{5}{10}$ (v) $\frac{1}{10}$
   (b) (i) 0.35 (ii) 0.75 (iii) 0.07 (iv) 0.03 (v) 0.09

ANSWERS TO SELF ASSESSMENT EXERCISE 1

The Scheme of Work is broken into term plans for each year's work in a subject – (in this case – Mathematics). By this exercise the year's work will be broken into the three terms that make up the year. Following this, each term's work will further be broken into the number of weeks in the term.

The advantages of a Scheme of Work include the following:

(i) It helps the teacher to arrange the terms work in logical sequence.
(ii) It enables the teacher to distribute the term's work, and therefore the year's work evenly, thus preventing unnecessary rush and repetition.
(iii) It will help him to prepare necessary materials that will be needed for each topic ahead of time.
(iv) In case of transfer of the teacher a well-prepared scheme will enable the incoming teacher to know what has been done and where he should begin his own work.

ANSWERS TO SELF ASSESSMENT EXERCISE 2

The unit plan is the mid-way stage between the Scheme of Work and daily lesson plan. It is made up of a set of related learning experiences obtained from the break down of a mathematical theme concept or topic into units of different lesson.
The features of a Unit Plan include the following:

(i) The subject
(ii) The name of the unit
(iii) The class for which the unit is planned
(iv) Objectives of the unit
(v) Entry behavior
(vi) Deciding the area of the unit to be covered in each lesson
(vii) Identifying the methods and teaching aids to use; which will make it easy to plan for the daily lesson.

4.0 CONCLUSION

This unit discussed the different ways of planning teaching activities; these includes through the drawing up of the Scheme of Work, the Unit Plan and the Daily Lesson Plan. These are integral parts of teaching activities and should not be overlooked by any teacher who wants to make a success of his teaching career.

5.0 SUMMARY

In this unit, you have been exposed to the types of planning for teaching activities which includes

(i) The need to plan, and the different types of planning for teaching activities
(ii) The format and Writing of a Scheme of Work.
(iii) The format and writing of a daily lesson plan.
(iv) A sample lesson plan.

6.0 TUTOR MARKED ASSIGNMENT

(i) Of what importance is the lesson plan for the teacher?
(ii) Write down the essential features of a daily lesson plan.

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MODULE 2

Unit 1 Individual differences in mathematical achievement, and how to cater for them.
Unit 2 Motivating students towards learning of mathematics
Unit 3 Instructional aids in the teaching and learning of mathematics
Unit 4 Instructional Aids in the Teaching and Learning of Mathematics II

UNIT 1 INDIVIDUAL DIFFERENCES IN MATHEMATICAL ACHIEVEMENT AND HOW TO CATER FOR THEM.

CONTENTS

1.0 INTRODUCTION

In this unit, you will learn about the differences in mathematical abilities of learners, the source of this differences and how to cater for them.
Happy reading.

2.0 OBJECTIVES

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

i. Highlight the differences in the Mathematical abilities of learners and the sources for this difference.

ii. Explain the different ways a Mathematics teacher can cater for the differences.

3.0 MAIN CONTENT

3.1 Differences in Mathematical Abilities and Their Sources.

No two individuals are the same in every respect. Once you have a group of learners in your class, you have as many different individual as their number. In the mathematics classroom also, differences in abilities among individuals do occur as natural phenomenon. This difference is also observable in their mathematical abilities, these differences occur due to a number of factors.

3.2 Factors Giving Rise to the Differences

The factors that give rise to mathematical abilities in learners include the following.

3.2.1 Mental or Intellectual Ability

This means differences in ability to reason or think reflectively or to solve problems: This type of differences is innate or due to genetic factors. It cannot be ascribed to faulty background or deficient educational background. Mathematical ability that is due to this difference usually gets progressively widened, especially if each learner has the opportunity through encouragement to work to the best of his ability – this is because the causative factor is innate.

3.2.2 Background Mathematical or Educational Experience

Some learners are privileged to have better mathematical or educational background than others. Such privileged learners will have a hedge above others to the degree of their previous mathematical experience. This factor has to do with the learner's background environment. Generally a child's academic performance is not a function of innate abilities alone. Environmental factors also play a major role.

Miner, (1968) pointed out that "all children do not proceed with their academic careers on equal footing due to their socialization experiences in the home environment.

It is possible, for example that a ten-year-old child from a non-educated home may not be able to perform as well as an eight year old from andeducated home, at least in their initial exposure to formal school

work; this is because the later has a more privileged educational background.

Blackmore and Cooksey (1981) cited in Adeniyi (1987) particularly noted that "moderately able children from privileged backgrounds may over-achieve in school learning while intelligent children from under-privileged backgrounds may fail to make the most of their talents through environmental and educational disadvantages".

When these facts are related to mathematical learning, it may give him an edge or place him a disadvantage depending on his home background experience.

3.2.3 Factors Relating To Motivation, Interest and Attitude

Motivation is that propelling forces which drives someone (the learner in this case) towards a particular goal. A well-motivated learner will eventually develop interest in that towards which he is motivated. With respect to mathematical learning, a learner who is motivated towards learning mathematics will eventually develop interest in it. And it has been found out that attitude and achievement have reciprocative effect on each other in that attitude affects achievement and achievement affects attitude. Hence factors such as motivation, interest and attitude all link together to affect mathematical achievement Pidgeon (1971) specifically asserted that "the motivational factors in the home background, such as the interest and attitude of parents is important in influencing children's school performances". With respect to the learning of mathematics; when parents consistently show interest in their children's progress, and/or they provide help by explaining difficult homework, or give verbal encouragement, it will all serve to motivate the child towards learning mathematics. This motivation will also improve his attitude and interest and in all probability will lead to better performance in mathematics than his counterparts who do not receive such motivation.

3.2.4 Physical Factors

Existence of some physical defects will in all probability negatively affect the performance of a learner and may make him perform poorer than his colleagues of seemingly equal ability in other respects. For example, a child who cannot see will miss some facts written on the board for them to copy, and the missed facts may be a key element that may bring his down his performance among his peers. Similarly, a learner that has ear defect may miss some information or teaching facts passed across by the teacher verbally. This in turn may affect his performance negatively. In this way, physical disability may cause

differences in the mathematical performance of learners who otherwise would have been on equal footing.

SELF ASSESSMENT EXERCISE 2

Highlight and discuss the major sources of differences in mathematical abilities of learners.

3.3 How to Cater For the Differences

The section above must have acquainted you with the source of differences in mathematical abilities. This will also further confirm that learners have individual differences, so they are not the same in every respect; and the effect of their differences will reflect in how they learn, the rate at which they learn, their performances in mathematics etc. For this reason, teachers should not expect learners to learn at the same rate, or in the same way, or in the same specific given time under the same conditions. Rather, the teacher should endeavor to cater for the differences by providing conditions or situations under which his learners can best be helped to learn so that the learner will not suffer or be disadvantaged because of the differences. The following are some ways in which the differences can be catered for.

Particularly, the teacher needs to know that some individual differences are such that all learners may not be given the same mathematical contents or the same assignment; they need different amount of time to work and all may not be expected to score the same mark.

The following are some ways in which the differences can be catered for.

(i) Group the class according to their abilities. Write out mathematical exercises whose difficulty level are graded; then give to each group mathematical problems that is commensurate to their ability. Ensure that the problems given to each group is such that each learner has a chance of succeeding.

(ii) Where the class is not grouped according to ability, the exercise can be varied in level of difficulty so that some set of questions can be tackled by every learner , including the weaker ones. In addition, a few difficult problems could be added for the more capable students to attempt.

(iii) The teacher can further help the weaker learners by giving them frequent individual attention, through re-teaching, clarification of issues etc. This will go a long way to alleviate their difficulties.

(iv) Teachers should endeavor to enrich the teaching by making use of concrete teaching aids to help the weak learners comprehend more.

(v) While learners are working mathematical exercises on their own, the teacher can go round to offer individual assistance to weaker learners or to those that require such assistance. Such going round to help will enable the teacher to discover mathematical facts that has not been understood by a large number of students and may indicate if re-teaching is necessary.

(vi) On frequent basis, teachers should give diagnostic test, which will invariably be followed by remedial teaching.

(vii) The teacher can write individual assignment cards. Some of these may contain harder mathematical exercises while others contain additional exercises of a simpler variety. Harder exercises are meant for capable learners who complete the general problems early.

(viii) The teacher should be sympathetic with the weaker learners and should encourage them. He should not make jokes out of them nor call them uncomplimentary names.

(ix) Learners who are very good should be encouraged to help the weaker ones.

(x) The teacher should also help very good learners to cultivate the habit of self-study by encouraging them to learn more mathematical principles by themselves through reading

SELF ASSESSMENT EXERCISE 2

A group of fresh students in a College of Education who never had prior training in education offered the following suggestions on how to cater for individual differences in mathematics. Which of them will you agree with as a professional mathematics teacher? Write the letter A or D beside each to show Agreement or disagreement. A = Agree. D = Disagree.

(a) Use punishment or caning to force the weaker students to work harder.

(b) Award prizes to those who do well as a way of motivating them to work harder at mathematics.

(c) Refuse slow learners to go out during break and force them to do extra work in mathematics.

(d) Enrich your mathematics lesson more by using more relevant instructional materials to help weaker learners.

(e) Ignore those slow learners since they are not pulling their weight in mathematics class.

(f) Make the good students go out and play during mathematics lesson so as to allow weaker ones to catch up.

(g) Vary your methods to make mathematics more interesting to enable weak learners to be jolted up.
(h) Put learners into groups according to their ability and give more frequent help to the weaker.
(i) Make-learners who score too poorly to withdraw from mathematics class.
(j) Remain sympathetic with the students and always encourage them to work harder as they can do better.

4.0 CONCLUSION

It is important that mathematics teachers have awareness that as individual learner differ from one another, so are there differences in mathematical abilities among learners. He should therefore seek to know his learners and areas of their mathematical weaknesses and strengths. Having done that, he should deliberately plan to help them to achieve their best in mathematics.

5.0 SUMMARY

The following are the major issues discussed in this unit.

(i) Differences in mathematical abilities and their sources.
(ii) Factors giving rise to the differences which includes the following:

(a) Mental or intellectual ability
(b) Background mathematical or educational experience
(c) Factors relating to motivation, interest and attitude and
(d) Physical factors

Finally, it discusses the various ways of catering for the differences.

6.0 TUTOR MARKED ASSIGNMENT

In order not to put the weaker learners at a disadvantaged position, every teacher should learn to cater for the differences found among his learners. Hence, mention 10 ways you will use to cater for the differences in mathematical abilities among your learners.

ANSWERS TO SELF ASSESSMENT EXERCISES

SELF ASSESSMENT EXERCISE 1

The major sources of differences in mathematical abilities of learners include the following.

(i) Mental or Intellectual Ability
(ii) Background in mathematics or Educational experience
(iii) Factors relating to motivation, Interest and attitude.
(iv) Physical factors.

The above-mentioned points are discussed below:

(i) Mental or Intellectual ability: - This refers to differences in ability to reason or think, reflectively or to solve problems.
This type of differences is basically due to genetic factors. It cannot be ascribed to faulty background or deficient educational background.

(ii) Background in Mathematics or educational experience:- Some learners are privileged to have better mathematical or educational background than others. Such privileged learners will have a hedge above others to the degree of their previous mathematical experience. This factor has to do with learner's background environment.

(iii) Factors relating to motivation, interest and attitude: - Motivation is that propelling forces which drives someone, (the learners in this case) towards a particular goal. A well-motivated learner will eventually develop interest in that towards which he is motivated.

(iv) Physical factors: Existence of some physical defects will in all probability negatively affect the performance of a learner and may make him/her perform poorer than his colleges of seemly equal ability in other respects.

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UNIT 2 MOTIVATING STUDENTS TOWARDS LEARNING OF MATHEMATICS

CONTENTS

1.0 INTRODUCTION

The importance of motivation as a factor to enhance learners interest cannot be over emphasized. Students that are motivated will develop interest in mathematics, will work hard at it and consequently will have good performance in it. In the light of its importance, this unit will discuss motivation, its importance and how to motivate students towards learning mathematics. You will enjoy it – happy reading.

2.0 OBJECTIVES

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

(i) Explain the meaning of motivation
(ii) Talk about the importance of motivation
(iii) Highlight ways of motivating students towards learning mathematics

3.0 MAIN CONTENT

3.1 Fighting Negative Attitudes towards Learning of Mathematics

Negative attitude and lack of motivation are among the factors given as being responsible for poor performance of learners in mathematics. It follows then by hypothesis that well motivated learners will improve in their performance in mathematics and consequently will develop positive attitude toward the subject. For one thing, the poor performance of students in mathematics may be the cause of negative attitudes as inability to do mathematics and not liking it seen to go together. For example, Neale (1969) found out from study that attitude and achievement have a reciprocal effect in their relationship in that attitude affects achievement and achievement affects attitude. Hence motivating learners towards learning of mathematics will directly or indirectly lead to development of positive attitude towards mathematical learning. When this is achieved, a major problem in mathematical teaching and learning would have been solved.

There is therefore a great need to motivate learners towards learning mathematics; motivation will serve as an inner force that will propel their interest towards mathematical learning. If this is so, the major task facing every mathematics teacher is how to arouse his learner's interest towards the learning of mathematics through appropriate motivation. This will go a long way towards improving learner's attitude towards the subject.

3.1.1 Meaning of Motivation

From the Oxford Advanced Learner's Dictionary, to motivate means to make somebody want to do something especially something that involves hard work and effort for example a highly motivated student is one that is very interested and works hard.

Motivation can then be defined as a stimulus that produces a strong desire to do something. Motivation can be stimulated from two sources or in two ways i.e. from internal forces or from external forces.

Internally generated motivation is caused by a stimulus from within an individual, or from inside him and is called intrinsic motivation. Factors that generate intrinsic motivation are derived from individual cravings and may include such things, as the individual needs, his interests, aspirations, wants, attitudes etc.

e.g. The need to meet financial obligations can make someone accept an odd job because it will give a good pay.

Externally generated motivation is caused by external stimulus or by forces that are external to the individual, or by forces within the environment e.g. home, school, city(ie the environment in which that individual resides) and people e.g. peers, parents, friends etc. in the same environment. Such factors are called extrinsic factors; and include factors like expectation of others from home, societal attitude towards a particular thing; what the society rewards or punishes etc.

For example, a child from a home in which every sibling attains first degree as a minimum level of education will be motivated to read up to first degree at least, so that he won't be an odd one among others, whereas one from a home where the highest attainment is first school leaving certificate may not have such a motivation.

SELF ASSESSMENT EXERCISE 1

(a) What is the meaning of motivation?
(b) Differentiate between intrinsic and extrinsic motivation

3.1.2 The Importance of Motivation

Motivation is important because it can be a driving force to make someone develop interest in or make him do something, which otherwise he would not.

For example, money is a motivating force that gets people to discipline themselves in order to work or even do some odd job.

For instance, because of the pay package at work, people can subject themselves to some inconvenient situations or conditions like learning home by 5 am and returning by 8 pm or even later, not having time for recreation, nor enough time with the family. Although they may not like the associated condition or even the work, they submit to such, and many that are jobless are competing to get into those inconvenient conditions because of the money received from it at the end of the day.

For the sake of the money, people can subject themselves to odd jobs like washing gutters and toilets for other people, getting involved in boxing, where they may end up being injured, loose teeth, break jaw, or get swollen eyes-yet the monetary gain at the end of the show propels them to do it.

In a similar fashion, although students may naturally not like mathematics when they are led to know the gains, derived by doing it, those benefits or gains will serve as a motivating force propelling them to learn mathematics. Hence the effort being made in this unit is to harness ways and methods of motivating learners toward learning mathematics.

SELF ASSESSMENT EXERCISE 2

(a) What is the general importance of motivation?
(b) Why is it of importance to the learning of mathematics?

3.1.3 Methods of motivating learners towards learning of mathematics

There are a number of methods that can be used to motivate learners towards learning of mathematics they include the following.

3.1.4 Learner's participation in the learning process.

When learners are actively involved in the learning process in the mathematics lessons through being given the opportunity to find out by themselves it arouse their curiosity to know or to find out. Therefore, teachers should discourage the use of chalk-talk approach of teaching mathematics. Rather, they should embrace the investigative approach of teaching mathematics where learners are given the opportunity to find out through the use of concrete or relevant illustrative instructional materials. This may involve you the teacher using deductive approach of teaching in which students are led through step by step activities to arrive at generalization or the rules behind the concept being taught. For example in the teaching of triangles; suppose the teacher wishes that his learners understand that the sum of angles in a triangle is 180^0. The traditional or the talk-chalk approach is to read out the theorem and, or, write the theorem on the board as follows:

Theorem: - The sum of angles in a triangle is 180^0. Following this, he may work a few examples and the board to illustrate the theorem. He may then give class exercises related to this topic to the students to work. All that the learners have to do is to memorize the theorem which again can be easily forgotten.

However in the investigative or deductive approach, the teacher with the use of relevant instructional materials and proper guidance will allow the learners to discover this theorem by themselves. The following is an example of such procedure

CLASS: **JSS II (Sec. Sch.)**
TOPIC: The sum of angles in a triangle
Aim: Students will know and be able to apply the face that the sum of angles in a triangle is 180^o
Apparatus: (1) Paper triangle cut out
(2) Work sheets

Previous Knowledge: Student has done construction work.
Instruction: Perform the following exercises and answer all questions that are asked.

I. Construct triangles ABC with the following dimensions:

1. AB = 5cm	BC = 4cm	$<B = 50^o$
2. AB = 6cm	CA = 2.5cm	$<a = 105^o$
3. BC = 4cm	CA = 7cm	$<C = 78^o$
4. CA = 5cm	$<A = 37^o$	$<C = 90^o$
5. BC = 6cm	$<B = 116^o$	$<C = 10^o$
6. AB = 7cm	$<A = 35^o$	$<B = 64^o$

11. Measure angles of the triangles constructed and complete the following table

Triangle	**1st angle**	**2nd angle**	**3rd angle**	**sum of the Three angles**
1				
2				
3				
4				
5				
6				

What did you get for the sum of these angles of each of the triangle?

III. Take a piece of paper, and cut out a triangle. Tear off the vertices and place the angles together as shown below.

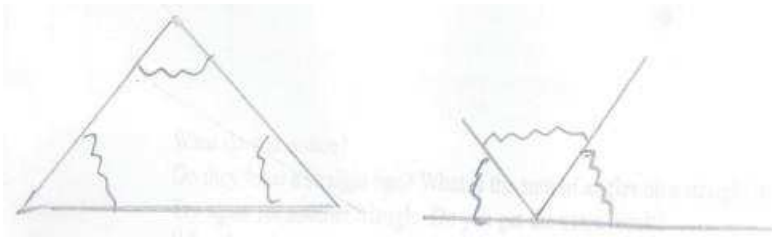

Fig (a) Fig (b)

What do you notice?

Do they form a straight line? What is the sum of angles on a straight line?

Try again for another triangle. Do you get the same result? What does this show you about the sum of angles in a triangle? The sum of the 3 angles of any triangle is _____.

IV. Attempt the following exercise

The table below shows 2 of the angles (measured in degrees), of ABC for some different triangles. Find the missing angle in each case.

	Angle A	**Angle B**	**Angle C**
1	25	50	
2	41	79	
3	102		23
4	90	37	
5		67	74
6	82		28
7	66	77	
8		23	18

Without doubt, a student who goes through the above steps to the stage of discovering that the sum of angles in a triangle is 180^0 will have gone through the following experiences:

(i) He has actively participated in the learning process

(ii) His curiosity will have be aroused to know where the exercises in steps (i) & (ii) would lead to

(iii) He would have been amazed to note that he was getting 180^0 for all the sums of angles in steps ii, and would be interested to find out what the conclusion would be

(iv) By the time he has completed step iii, he would be able to say conclusively that the sum of angles in a triangle is 180^0 – that is discovery. This would definitely give a sense of achievement, and he will be able to say that mathematics is also interesting. He will be motivated to learn more and with more of such experiences his attitudes towards mathematics will improve.

Hence a discovery / deductive approach in which learners actively participate in the learning process is one major way to motivate students towards the learning of mathematics.

3.1.5 Teaching applications of mathematics

Although mathematics has been widely acclaimed as the queen and servant of all subjects; that no other subject has greater application than mathematics yet it is equally true that learners are more often not aware of the various applications of mathematics. They do not see its usefulness in every day life. In fact, some students have attributed their hatred of mathematics as a subject to the fact that they cannot see its relevance to every day life. It is therefore important that learners are taught and made to understand the importance of mathematics and its relevance to everyday life.

Learners need to know for example that mathematics was developed as a result of man's effort to solve a major problem of his day. For example, numeral was invented to help man have a way of counting and keeping record of his properties such a sheep, goats and other personal belongings.

As per its applicability, mathematics has applications in all areas of human endeavor, for example, it can be used to forecast population growth, business growth, it is used to predict rainfall and agricultural yields; through statistical generalizations and conclusions administrators mathematics for budgetary planning and to make educational projections etc.

As a service subject, its services touch almost every area of discipline for example in geography, the aspect of practical geography requires the knowledge of ratio and proportion to be able to draw maps to scale i.e. either to enlarge or reduce given maps. Cartography also requires the same mathematical concepts in addition to some geometrical knowledge like angular measure. Physics makes use of mathematics so much that it has been asserted that without mathematics, there can hardly be any physics. Differential calculus has relevance to the study of plant growth in biology rate of growth of plants can also be illustrated by graphs. The study of survey draws so much from trigonometrically knowledge like sines, cosines, tangents; gradients, knowledge of right-angles, triangles etc. Even in fine arts, the study of patterns, symmetry, reflections, and rotational movements has a lot of relevance. When the various uses and application of mathematics in different areas of life are taught to learners, it will serve to motivate them and get them interested in the study of the subject.

3.1.6 Home background and parental encouragement

The home background of a learner has a strong influence on his educational achievement and this includes mathematics

This is so because the child understands about the values his home (family background) places on mathematics and successful performance in it serves as a motivation and consequently affects his actual performance in it. From research it has been found out that what the child learns at home and how his family motivates him towards education contribute to the child's success or failure in school; (Uche 1980) this also will not be less true about mathematics. Further on home background, the interest and attitude parents show towards mathematical achievement of their children are also source of strong motivational factors to the child.
This is done through

(i) Continuous encouragement given to the child by the parent towards learning mathematics
(ii) High expectation which parents have about their child's performance and
(iii) The attitude of parents themselves towards mathematics as a subject. Therefore the home and particularly the parents can do a lot in motivating their children towards learning mathematics and getting them to develop interest in the subject

3.1.7 Teachers' Role in Motivating Learners

The role that teachers can play in motivating their learners towards learning mathematics cannot be brushed aside. It is to be noted that teachers' attitudes towards mathematics will significantly affect his learners' attitudes towards mathematics. Hence a well-motivated teacher will to a large extent be able to motivate his learners. However an unmotivated mathematics teacher, who himself feels insecure in teaching it, who fears and dislikes it, and who himself does not have a proper understanding of the basic concepts he is called upon to teach cannot help transferring these negative traits to his learners. In a similar vein, a teacher who is confident has understanding and a good grasp of the subject matter, who displays interest in the subject, will affect his learners with these positive traits. Such a teacher will be able to motivate his learners with ease and get them interested in learning the subject. This is so because his positive disposition towards the subject has provided a conducive learning environment for his learners which is a basic requirements for learning

In addition, other things a teacher can do to motivate his learners include the following: - from time to time, he could let his learners know the importance of mathematics to their present time and future career. Not doing well in mathematics can hinder them from entering profession like Engineering, Agricultural sciences, and other science oriented professions; Architecture, Surveying and some business oriented professions.

He can also motivate them by telling them stories of some past mathematician and how their achievement has helped today's world. Hence teachers of mathematics can do much to enhance motivation of their learners towards mathematics

3.1.8 Other ways of motivating learners

Other ways of motivating learners includes:

(i) Use of games and mathematical recreations; mathematical gains can be used to sparkle interest and bring about a lively atmosphere in a mathematics classroom. In this way it can become a medium for motivating the learning of mathematics

The use of mathematical recreations can also be used to relieve boredom, this can be in form of creating patterns, tessellations, paper folding, giving mathematical puzzles.

(ii) Mathematical clubs formation and running a mathematical clubs can provide a good forum for motivating learners towards learning of mathematics the club can organize programmes of mathematical interest, like symposium, debates that are mathematically oriented. For examples, in such programme topics that make students see importance of mathematics as a discipline; careers that needs mathematics; how mathematics enters other discipline etc. will go a long way, to both motivate and enlist other learners' interest in mathematics.

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

(a) Motivation can be defined as a stimulus that produces a very strong desire to do something. Motivation can then be stimulated from two sources or in two ways i.e. from internal forces or from external forces.

Internally generated motivation is caused by a stimulus from within, why externally generated motivation is caused by external stimulus.

(b) Intrinsic motivation is also known as internally generated motivation which is caused by a stimulus from within by an individual. Factors that generate intrinsic motivation are individual cravings and may include such things as the individual needs, interests, aspirations etc. while extrinsic motivation is known as the externally generated motivation which is caused by external stimulus or by force within the environment e.g. home, school, city, etc.

SELF ASSESSMENT EXERCISE 2

(a) Importance of motivation.

Motivation is of utmost importance because it can be a driving force to enable someone develop interest in or make him do something, which otherwise he will not.

(b) Motivation is of importance to the learning of mathematics because when the students are made to know the gains and benefits they stand to have by learning mathematics. It can serve as a propelling force to make them learn it even though they naturally hate the subject.

For example, money is a motivating force that makes people discipline themselves to do certain odd jobs. Hence, the driving force is of utmost importance in the learning of mathematics.

4.0 CONCLUSION

Getting learners motivated is a major way of getting them interested in learning mathematics and consequently improving both their attitudes and performance in it. Since these are major ingredients in getting students to learn mathematics every one involved in bringing this about should be encouraged to do so, and all means to achieve this important factor should be employed.

5.0 SUMMARY

The following are the major issues considered in this unit:

(i) Fighting negative attitude towards learning mathematics
(ii) Meaning of motivation
(iii) The importance of motivation
(iv) Methods of motivating students which includes
(a) Learners participation in the learning activities
(b) Teaching applications of mathematics
(c) Home background and parental encouragement
(d) Teachers' role in motivating learners

(e) Other ways of motivating learners.

6.0 TUTOR MARKED ASSIGNMENT

(a) Define motivation and explain
  (i) Extrinsic motivation
  (ii) Intrinsic motivation

(b) Highlight four major ways by which learners can be motivated towards the learning of mathematics.

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UNIT 3 INSTRUCTIONAL AIDS IN THE TEACHING AND LEARNING OF MATHEMATICS

CONTENTS

1.0 INTRODUCTION

The importance of using instructional aids in the teaching and learning of mathematics can never be over – emphasized. It can both enhance understanding of mathematical concepts and also stimulate students' interest in mathematical learning. In this unit you shall be exposed to the place of instructional aids in mathematics classes.

2.0 OBJECTIVES

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

(i) Highlight the use of instructional aids in the mathematics classroom.
(ii) Relate the purposes of instructional aids in the mathematics classrooms
(iii) List and discuss some specific types of instructional aids

3.0 MAIN CONTENT

3.1 The use of instructional aids in mathematics classroom

Instructional aids are learning resources used by the teacher or learners or both in classroom teaching to enhance understanding. They therefore help to make teaching and learning more effective. Mathematics teachers should see the use of instructional aids as a matter of necessity in their teaching, especially at the primary and secondary levels. Mathematics has to do with development of concepts and skills; these concepts are abstraction from concrete real life situations. When learners are given the opportunity of going through the process of such abstraction through the use of instructional aid, it will help them to both appreciate and understand the concepts more Piaget, a psychologist who worked on the cognitive development of children proposes that in the course of learning, learners should be allowed to proceed from concrete through semi concrete and finally to the abstract stage. This proposition is particularly relevant in the mathematics classroom. In the teaching of any concept, the teacher should provide opportunity for learners to interact with the concrete situation or material, investigations or experiment, from this stage to the semi – concrete and finally to the abstraction stage.

This procedure can be followed only through the use of instructional aids. The following section will further intimate you with various purposes of instructional aids

3.2 The Purposes of Instructional Aids in the Mathematics Classroom

Among other things, instructional aids serve the following purposes in a mathematics classroom.

(i) They make lessons clear and practical to learners
(ii) They help learners to retain the knowledge gained from the lesson
(iii) Curiosity and interest to learn are evoked in learners as they interact with the teaching aids
(iv) Learners gain first hand experience which is not possible with ordinary chalk / talk approach
(v) Learners are helped to discover mathematical principles by themselves
(vi) Mathematical lessons become more interesting and more meaningful to learners

(vii) Learners find it easier to understand concept taught to them
especially when concrete apparatus are used
(viii) They provide opportunity for activity –learning i.e. learning by doing
(ix) The help learners to recall what they have been taught more easily
(x) Teachers are also relieved of the problem of making long explanations
(xi) As learners work in groups as they use the apparatus, the spirit of cooperation is developed among them.

SELF ASSESSMENT EXERCISE 1

Highlight eight purposes of Instructional aids in the mathematics classroom.

3.3 Some Specific Types of Instructional Aids

Mathematics instructional aids that can be used in mathematics classroom are many and varied in types. Some of them include – real or concrete objects, models, pictorial aids, charts, chalk board, flannel boards, calculator / computer, audio-visual aids, mathematical games and mathematics laboratory. You will become more intimate with them as we examine each one by one

3.3.1 Real Life Objects

These are real objects that can be used in the course of teaching or learning. For example, for primary mathematics topics like counting, and basic number works like addition, subtraction multiplication, division etc. real materials like seeds, bottle tops, set of sticks etc. may be used as counters. In teaching money arithmetic, actual currency may be used at the initial stages to illustrate buying and selling at the classroom corner shops. When teaching weight and measures, actual objects like tables, length & breath of classroom etc. can be measured; books and other real life objects can be weighed. All such objects that are used are instructional aids in real or concrete forms.

3.3.2 Models

Mathematical models are concrete material which is representations of the objects to be learnt about. They are usually three dimensional i.e. having length, breadth, and height / depth; examples of such models include cube, cuboids, dieses block etc. As instructional aids they:

(i)

Provide a concrete visualization of the real object

(ii) Thy aid, simplify and clarify the description of mathematical ideas
(iii) They make the abstracted ideas clear and facilitate creative thinking

3.3.3 Charts

A chart as an instructional aid is a sheet of paper containing information in form of curves, diagrams, maps, graphs, formulaic, equations which guides and train students for accurate work. This type of aids are not manipulatable, they can only be seen and touched

3.3.4 The Chalkboard

The chalk board is also called the black board because it is traditionally painted black to contrast the white chalk that is commonly used. It is an age long aid and one of the most instructional aid used in the classroom.

It is normally used to develop the main ideas being discussed during the lesson. This can be summary of the key points of the lesson, or for drawing figures, for solving problems etc. the teacher should make effective use of the chalk board by ensuring that he writes clearly on the board so that all learners can see including those at the back of the classroom. The general lay out of the blackboard work must be neat and well organized. When necessary and where the size of the chalk board permits, the chalk board work may be partitioned into two or three section by using chalk to draw vertical lines across the board. This usually improves the management of the chalkboard.

3.3.5 Flannel Board

This instructional aid is usually made with hard wood like plywood. Its surface is then covered with flannel, or blanket or any material having rough surface. It is generally used to display pictures, diagrams, charts or any such thing the teacher want to display to students. Material for display on the flannel board must also have their backs rubbed with sand paper flannel or any such rough material which will enable their backs to stick to the flannel board surface and stay. As the teacher teaches, any drawn materials meant to illustrate the teaching can be displayed on the flannel board, the flannel board is movable, it can be brought in when needed and kept away when its use is no longer demanded.

3.3.6 Text Book

The text book is an instructional aid that is most frequently used by teachers than any other, while this is proper and good, mathematics

teacher should not limit himself to only the use of text books; he should supplement his teaching with other instructional aid especially concrete or model types, or which ever among the numerous alternatives he deems best to enhance students understanding. Mathematics is an abstract subject, and it is one of the reasons why learners don't enjoy learning mathematics. Using appropriate instructional aid will go a long way to helping learners understand the abstraction and help improve their attitude toward learning the subject.

A good mathematics text book will offer tremendous help to mathematics teachers whose background and methodology is not adequate. Most text books provide most of the content for a course, they also provide exercises for practice, and it can be used for independent study by learners too.

In selecting the mathematics text to use, it must be checked to be adequate in much respect, some of which include the following:

(i) The topics must conform to the current curriculum being emphasized by the school,
(ii) It most is appropriate in terms of interest correctness difficulty as well as its usefulness for learners offering the course.
(iii) The mathematical computation of worked examples must be correct straight forward and easy to understand.
The language must be simple and comprehensible.

3.3.7 Others

There are other various instructional aids for various uses in the classroom. These include hand calculators / computer that can aid in computational work. Audio visual materials like television, radio etc. can also be used as instructional aids when and where relevant. Mathematical games can be used both to aid the teaching / learning situation and to spark interest in the mathematics classroom. Laboratory teaching is both an approach of teaching as well as an aid to understanding mathematical concepts. Hence as a mathematics teacher, you have a lot of resources that can be used to enhance your teaching and also aid your learners in their quest for understanding,

SELF ASSESSMENT EXERCISE 2

Mention and discuss five types of instructional aids that can be used in the teaching and learning of mathematics

ANSWERS TO SELF ASSESSMENT EXERCISES

SELF ASSESSMENT EXERCISE 1

Eight purposes of instructional aids include the following:-

(i) They help to make the lesson clear and clear to learners
(ii) They help learners to discover mathematical principles by themselves
(iii) Learners find it easer to understand concept taught to them especially when concrete materials are used.
(iv) The spark interest and arouse the curiosity of learners as they interact with the instructional aids
(v) They provide learners with opportunity for active learning
(vi) Learners gain first-hand experience which is not possible with ordinary chalk / talk approach.
(vii) Learners are enabled to recall what the have been taught more easily
(viii) Instructional aids also relief the teacher of the problem of making long explanations.

SELF ASSESMENT EXERCISE 2

The following are three types of instructional aids that can be used in mathematics

(i) Charts

A chart is an instructional aid prepared on a sheet of paper with information form of curves, diagrams, maps, graphs etc. this types of aids is not manipulatable but they can be seen by students i.e only the use of the learners sense of sight is appealed to.

(ii) Flannel board

This is an instructional aid that is made with hard wood, such as plywood. The surface is then covered with flannel, or blanket or any material having rough surface .a flannel board is generally used to display pictures, diagrams, charts etc. which the teacher want to show to learners, such materials to be displayed should have their backs rubbed with sand paper or any such rough material that will enable their backs to stick to the flannel board.

(iii) Models

These are concrete materials which are representations of the objects to learn about. Usually, they are three dimensional in shapes i.e having length, breadth and height. Examples of models are cubes, and cuboids. Models:

(i) Provide concrete visualization of the real object of study
(ii) They aid, simplify, and clarify the description of mathematical ideas
(iii) They make the abstracted idea clear and facilitate creative thinking.

4.0 CONCLUSION

Instructional aids play an important role in the teaching and learning of mathematics; it aids the teacher in his effort to get learners understand his teaching; it also aids the learners to figure out what the teacher is teaching and enhance their understanding as well

The use of instructional aids should not be an optional matter to a mathematics teacher; rather it should be seen as highly essential to his work. This is particularly so because of the abstract nature of mathematics, and this present an impediment to learners in their learning of mathematics. When appropriate use is made of instructional aids, it will play a big role in removing this impediment to learners.

5.0 SUMMARY

The following are the highlights of what you have been exposed to in this unit.

(i) The use of instructional aids in mathematics classroom.
(ii) The purposes of instructional aids in mathematics classrooms.
(iii) Finally some specific types of instructional aids was also listed and discussed.

6.0 TUTOR MARKED ASSIGNMENT

(a) What are the importance of instructional aid to the teaching and learning of mathematics?
(b) Write on the following as instructional aid in the teaching of mathematics
  (i) Textbooks.
  (ii) Models
  (iii) Flannel board.

7.0 REFERENCES/FURTHER READINGS

Ezike R.O and Obodo G.C (1991). The teaching of mathematics in Schools and Colleges. Division of General Studies, College of Education, Eha-Amufu, Anambra State

Samo D.A (1975). Mathematics methods for schools and Teacher Training College. Abiprint & Pak Limited Ibadan

UNIT 4 INSTRUCTIONAL AIDS IN THE TEACHING AND LEARNING OF MATHEMATICS II.

CONTENTS

1.0 INTRODUCTION

In the last unit, you were taken through the use of Instructional aids and their purposes in the mathematics classroom, some specific types of Instructional aids were also listed and discussed. In this unit you will be exposed to other aspects of Instructional aids in the teaching and learning of mathematics.

2.0 OBJECTIVES

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

(i) Identify good instructional aids by their features
(ii) Outline factor of consideration in using instructional aids
(iii) Discuss production of instructional materials locally
(iv) List guidelines in producing instructional aids locally

3.0 MAIN CONTENT

3.1 Features of Good Instructional Aids

If Instructional aids are to serve the purposes for which they are engaged; they must possess certain characteristic.

(i) If the actual objects needed, are not available, then the aids should be a true picture of what they represent.

(ii) Whenever possible, each learner or groups of learner should be given the specimen, if this is not possible, their sizes must be adequate for learners to see from a distance.

(iii) They should be easy to understand, and must be suitable for the age and experience of the learners.

(iv) Instructional aids should be relevant to the lessons they are used to illustrate.

(v) They should not be too costly or elaborate but they must be good enough to worth the time expense and efforts sacrificed to obtain them.

(vi) Whenever possible, local materials should be used in making them to reduce their cost.

(vii) The most important function of instructional aid is to contribute to the understanding of the lessons they are used to teach; the teacher must ensure that this purpose is achieved.

(viii) They should be neat, brightly colored and attractive especially when they are to be used for learners in lower classes.

(ix) If the aids are charts, they should be well labelled, with clear bold lettering. It must have a heading, written clearly so that pupils at the back can see it without problems.

(x) If the instructional aid is a gadget that requires operation, the teacher must posses the ability to operate, use and explain such a gadget, where he cannot he must bring someone who can operate to assist him.

(xi) The facilities or materials needed to operate or use the aid must be available. For example, if electricity is required for its operation, then light must be available in the premises; or if an video or CD is to be watched, then a television set or CD player must be available.

(xii) An instructional aid should not be too complex or the type that can damage quickly.

3.2 Factors to be considered in the Use of Instructional Aids

In considering the type of instructional aid to be used for a particular lesson the following need to be borne in mind.

(a) The instructional aid is not the teacher and it should not replace the teacher. It is supposed to aid the teacher in his effort to help learners understand his lesson. Therefore, Instructional aid must not be made to play the role of a teacher.

(b) In all teaching endeavors, there are always objectives to be achieved; the teacher should be guided by the objective of the mathematical lesson in selecting the Instructional aids to use. He should use that which will enable him to achieve his objective.

(c) Instructional aids selected for use must help both the fast and slow learners i.e. it must cater for individual differences

(d) The teacher should endeavor to vary the instructional aids he uses; it should not be the same for every lesson, otherwise it will no longer interest the learner.

SELF ASSESSMENT EXERCISE 1

What two factors will you take into consideration in using instructional aids?

3.3 Production of Instructional Materials Locally

Whenever possible, teachers should endeavor to produce some of the instructional aids needed in the mathematics classrooms locally. To do this, the learners too may be involved in the construction of such materials. Some special period say a free period can be arranged during which the whole class works on production of particular instructional aids to be used in some near future.

Sometimes interdisciplinary arrangement can be made such that learners' work on production of specified instructional aid during the art classes. It can also be given to learners as take home assignment such that learners produce such from home after all the technicalities involved has been shown to them at school.

Another major way to produce instructional aids locally is to make all final year learners produce a specific instructional aid as their project and leave such for the school use; this is particularly suitable for learners in Colleges of Education. Such projects will their minds on the importance of using instructional aid in their own classrooms too.

This effort to produce instructional aids locally is important for a number of reasons.

(i) It may not be feasible to expect the school authority or the Government agency concerned to buy all instructional aids that will be needed in the classroom, the cost will be formidable and

so it may just be ignored. This in part may be the reason why mathematical instructional aids are lacking in most schools in Nigeria. Hence local production of such instructional materials may be the way out. This will drastically reduce cost of procurement of such aids, or may even eliminate money altogether in some cases.

(ii) Even if funds to buy all that is needed are available, some important/basic and relevant aids may not be available in the market.

(iii) Another good reason for local production is that the process of production itself is very educative. The fact that learners have been part of the production may help them to understand the concepts faster.

SELF-ASSESSMENT EXERCISE 2

Give three reasons why a mathematics teacher should consider producing instructional aids locally.

3.3.1 Guidelines in Production Process

This unit is not about showing how to construct different type of instructional aids, but to give some general guidelines.

Generally some basic materials that can be used as tools should be available; such includes cardboards, rulers, colored pencils, letter stencils, blade, gum, knife, scissors, nail, plank or plywood, etc.

Generally too, the type of instructional aid to be produced will determine the specific type of materials to use. For example, in production of charts. Three types of materials are basically needed, which includes:

(i) Fabrics, i.e. the basic structure that will hold the drawing – this may be cardboard, newsprint or wrapping paper.

(ii) Lettering materials – this can be ink of various colours, tempo or markers.

(iii) Choice of suitable colours.

After production, if the edges are to be protected, it can be binded or if the surface is to be protected, it can be enclosed in cellophane.

In the production of models, the type or make will also determine the materials to use. For models in which the internal structures are required to be seen, transparent materials like glass or cellophane should be used. However, if only the external are required to be examined, opaque materials may be used to make the models.

Generally however, for any type of instructional aid, it is advisable to use durable materials to avoid quick damaging so that the items can be used for long. It is also a good idea to consider a good storage facility where all the Instructional aids can be safely kept, and from where they could be brought out when needed.

ANSWERS TO SELF ASSESSMENT EXERCISES

SELF ASSESSMENT EXERCISE 1

The following are two major issues to consider in using instructional aids.

(i) The instructional aid i will use will depend upon the objective of my lesson; i.e. what the lesson is out to achieve. One of the purposes of using instructional aids is to enhance the achievement of my lessons. I will therefore select for the use instructional aid that will help towards the achievement of the objective of my lesson.

(ii) The instructional aid is to help complement my effort as a teacher in achieving the objective of my teaching. I will therefore use it as such; i.e. I will not allow it to replace me, but rather to complement my effort. For example I will not leave the children unattended to just because I have given them instructional aid to work with.

SELF ASSESSMENT EXERCISE 2

Three reasons why a mathematics teacher should consider producing instructional materials locally includes the following:-

(i) The school or Educational agency may not be able to provide the fund required to purchase all the instructional materials that will require for all mathematics lesson. This is because the fund required may be huge; considering the fact that similar demands may be made by other subject teachers apart from other educational demands. If it is therefore left for the school/educational aids may not be available for use.

(ii) Sometimes, such instructional aids as may be needed may not be available in the market. So even if the funds were available, the needed materials may not be there; hence local production may be the way out.

(iii) The process of producing the instructional materials can be very educative because the producers are gaining experiences. Hence where the learners are involved in the production as in the case of

local production, they will learn in the process. This in turn may help them to understand better and faster the mathematical concept they are meant to learn through the use of instructional aids

4.0 CONCLUSION

The role of instructional aid in the teaching and learning of mathematics is so major that any mathematics teacher ought to see its usage as an integral part of his teaching. This being so, it is also important that the teacher make good selection of the instructional aids he will use, hence he needs to be acquainted with the features of good instructional materials.

In addition, it is important that the teacher consider producing most of the instructional aids that he will need and use as huge cost, inability to source fund and even non-availability of the items needed may hinder the good will of using instructional aids.

5.0 SUMMARY

In this unit, you have been exposed to:-

(i) The features of good instructional aids.
(ii) Factors to be considered when using instructional aids
(iii) Production of Instructional materials locally and
(iv) Guidelines in the production process.

6.0 TUTOR MARKED ASSIGNMENT

As a mathematics teacher, you should have criteria for selecting good instructional materials; give ten features of good instructional aids.

7.0 REFERENCES/FURTHER READINGS

Ezikwe R. O. and Obodo G. C. (1991) the Teaching of Mathematics in Schools and Colleges. Division of General Studies, College of Education Eha-Amufu, Anambra State.

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MODULE 3

Unit 1 Some methods that can be employed in the Teaching of Mathematics
Unit 2 Laboratory Approach of teaching Mathematics.
Unit 3 Individualized Instruction: An Effective Approach of teaching Mathematics.

UNIT 1 SOME METHODS THAT CAN BE EMPLOYED IN THE TEACHING OF MATHEMATICS

CONTENTS

1.0 INTRODUCTION

In this unit, you will be exposed to some methods of teaching, which can also be applied in the teaching of mathematics whenever a particular type is relevant. The methods treated in this unit include the discovery method, the group method and the lecture method. Two other methods are given separate treatment in later units because of their uniqueness and importance to the teaching of mathematics, these are (i) the

laboratory approach of teaching mathematics and (ii) the individualized approach to teaching mathematics. All these are for the purpose of enriching your resources for teaching mathematics.

2.0 OBJECTIVES

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

(i) explain what discovery method of teaching is all about, as well as its advantages and disadvantages

(ii) Explain what group method of teaching is all about, as well as its advantages and disadvantages.

(iii) Explain what lecture method of teaching is all about, as well as its advantages and disadvantages.

3.0 MAIN CONTENT

3.1 General Views on Methods of Teaching

Teaching methods is hereby defined as accepted formal procedures for transferring knowledge. The attempt in this discussion is not to pin-point a particular method as being the best because it has been found from research that there is no best method of teaching, Johnson and Rising (1971) pointed out that the method selected depends on the "the topic, the class, the objectives and the procedures" known to the teacher.

It is therefore considered paramount for (you) the teacher to be exposed to the various methods of teaching available so that any method deemed useful for a particular topic, class, or for the objectives under consideration can easily be drawn upon. This is considered necessary especially as far as mathematics teaching is concerned. For effective mathematics teaching, whenever the teacher is planning on a topic to teach, he should also consider the method that will be best for teaching that topic, and he should be knowledgeable enough to utilize the appropriate method. It should not be a case of using one method to teach all topics. Moreover in considering which method to use for a particular topic, the following guidelines will be helpful to you as the teacher.

(i) Ensure that you understand the method thoroughly

(ii) Ensure that the method will be effective for the topic you want to use it to teach

(iii) Ensure the method will help your learners to understand the concept you want to teach them.

(iv) Ensure the method will afford your learners opportunity to actively participate in the lesson. Where learners are passive

participants, you can not guarantee their understanding, nor will they be able to utilize such concepts in real life.

SELF ASSESSMENT EXERCISE 1

(a) Why does a teacher need to be exposed to various methods of teaching that are available?
(b) What four things should a teacher consider when planning to use a particular method of teaching?

3.2 Specific Methods

Following the above general considerations, some specific methods of teaching will be considered; these includes: discovery, group and lecture methods

3.2.1 Discovery Methods

There are two varieties of this method namely (i) the guided discovery and (ii) the open discovery.

3.2.2 (i) Guided Discovery

Under this approach, the teacher guides the learners either through the art of questioning or by explaining to them what they are to do; he then allows them to work on their own carrying out the activities designed for the period. With the appropriate guidance provided by the teacher, the learners usually discover the concept to be learnt; or the generalization to arrive at

(i) Open Discovery

This is the second variety of the discovery method. In this version, the learners are given free hand to interact with the learning materials and then come up with whatever discovery they can make. They are not given any guidance, as such, using this method learners can come up with discoveries that may be new to the teacher himself, owing to the fact that it waste a lot of time. Hence this version of discovery is not encouraged in our system.

3.2.3 Advantages of Guided Discovery

(i) It makes learners to participate actively in the lesson – they are the major actors and actresses, the teachers merely guide
(ii) Since learners make discovery of the concept to learn, they are likely to retain the knowledge learnt

(iii) Learners will also be able to transfer such knowledge gained
(iv) Since learners work on their own to discover knowledge, it will help them to develop ability and courage to solve other life problems.

3.2.4 Disadvantages of Guided Discovery

(i) Generally discovery method of teaching wastes time, for this reason the teacher should be well prepared to give hints and direct students when appropriate in order to reduce the time spent
(ii) Under this method, the classroom tends to be noisy as learners interact with materials and themselves – the teacher should use his expertise to check this.
(iii) Even with guidance offered by the teacher, not every learner succeeds in making the expected discovery. However, when majority of the learners have succeeded in their discovery, the teacher can use their own discovery to bring others to the results.

3.2.5 Sample Lesson on Guided Discovery

Topic The Circumference of a Circle

Instructional Materials:-

(i) Empty bournvita tin or any cylindrical object
(ii) Empty milk tin
(iii) Thread
(iv) Meter rule

Experiment

Divide learners into groups of two or three, and let them carry out the following experiment following the instructions given below.

(I) take the empty tin of bournvita and thread. Wrap the thread around the tin several times (let the wrappings form perfect circles around the tin i.e. don't let it bend). Also do not stretch the thread. Make 10 wrappings around the tin and cut the thread after the tenth turn. (N.B. – In any experiment, it is better to take the mean of several measurements rather than rely on a single one). Now unwrap the thread and measure its length with the meter rule. What is the circumference of the circular section of the tin? (Remember to divide the total length by 10)

(II) Also measure the diameter of the circle. Record your findings as shown in the table below.
Repeat the experiment with the empty tin milk and other circular objects you have and record similarly.

(III) Tabulate your results as shown in the table below

(i)	(ii)	(iii)	(iv)	(v)
Length Measured (ℓ)	**No. of turns Ten (n)**	**Circumference ($c = \frac{\ell}{n}$)**	**Diameter (d)**	**c ÷ d**

What do you notice about the results in column 5?
What is it equal to for all the cases?
(N.B. – It should be 22/7 if your work is accurate i.e. c ÷ d = 22/7)
The ratio 22/7 is called ⌀ (i.e. pi, the Greek letter p)
Now if c ÷d or c/d = 22/7 or ⌀
What is C⌀ Write it out.
N.B. (a) After the learners complete the assignment.
There should be class discussion to further clarify how the formula was obtained; this will also help those who could not arrive at the formula by themselves.
(b) This should be followed by blackboard example,
(c) Later, learners should be given exercises for practice.

SELF ASSESSMENT EXERCISE 2

What are the advantages and disadvantages of the guided discovery method of teaching?

3.3 Group Method

In a lesson that utilizes group method the class is usually divided into groups and each group is specifically given something to do. The assignment for each group is usually different from one another. The grouping itself may be done for different purposes. Some of the purposes include the following

(i) To provide for individual differences.

In a class where there is a wide range in achievement, it means there is wide differences in learning abilities of learners, and all cannot perform equally well on the learning contents at the same rate. In such a situation there is the need to provide means that will enable slow learners to progress at their own rate while fast learners are not necessarily hindered. One way to meet this need is to group the class according to their abilities (i.e. ability grouping). The mathematical works will also be graded, and each group will be assigned works that members can do and have a reasonable chance of succeeding. In this way, the needs of the learners i.e. their individual differences are provided for.

(ii) To conserve resources or to make judicious use of limited resources

There are occasions when due to large numbers of learners in the class, the available instructional aids that is essentially needed are far too few compared to the number in class. In order to give everyone a chance of using it, the class is divided into groups and the available aids are distributed among the groups such that every learner has access to it in his group.

At other times, there may be practical assignments for the whole class (like measurement activities) and the number of apparatus available is limited; yet it is considered important for learners to have an opportunity of handling or partaking in the activities. The way out in such a situation is to divide class members into groups and each group handle a portion of the assignments. Each learner can then have access to using such apparatus in his group.

(iii) For preparation of models or learning aids that may be used for later lessons

There are occasions when a teacher from his teaching plans realises that the class will need some certain models, or some instructional aids which learners can be organized to produce locally. The class may then be divided into groups, and each group works on producing a type of the models or a set of such instructional aids. This type of grouping may be called project grouping. Working this way, the class will be able to produce the required models; and their partaking in such production may even enhance their understanding of the related lesson later on.

In the various type of grouping, capable learners should be assigned to lead the groups.

3.3.1 Advantages and Disadvantages of Group Method

Listed below are some advantages and disadvantages of group method.

(a) Advantages of Group Method

(i) As learners work together, their interaction and inter communication within the group fosters social relationship which in itself is an achievement of major educational objective.

(ii) There is a development of healthy competition as the different groups work together and share their interests

(iii) In some kind of class work where learners work together to discover a formula or generalization; each group produces a pool of thinking and this can lead to making more discoveries in mathematical learning

(iv) The capable learners that lead the groups also have additional benefits. As they lead the groups, they learn mathematics, learn how to communicate and also gain experience in leadership roles.

3.3.2 Disadvantages of Group Method

(i) As learners work in group, their discussions and sharing of ideas may make the classroom more noisy than usual.

(ii) Also because of the nature of work in the groups, class control may not be as easy as during formal full-class lessons.

3.3.4 Sample Lesson on Group Method

Following a unit work on "Findings Areas' in a primary five class the following practical work is given.

The class is divided into four groups, each group is to calculate area of a particular section of the school compound as follows:

Topic:- Estimating areas of some sections of the School Compound.

Method: By Group activities as follows

Group 1	**Football field**
Group 2	**you're Classroom**
Group 3	**Assembly ground**
Group 4	**the School lawn**

Instruction

Each group is to go to the areas allocated to her; measure the length and breadth, and calculate the area of the portion allocated to them, and record their work. The over-all results will be compiled together as follows:

Group No	Name of Portion Allocated	Length	Breadth	Area

These results can be kept as a source of statistical information.

3.4 Lecture (or Telling) Method

Lecturing has been classified as the most conventional method of teaching. It is also the oldest method of teaching. Under this method, the teacher just goes to the classroom and delivers the learning contents to the learners. The learners are required to listen or copy or do both while the teacher speaks. This method of teaching does not require the opinions of learners. After the teacher has delivered the lectures, he may allow a few questions from learners for him to clarify – depending on the remaining available time.

This method of teaching has been tagged with other names as "teacher-centered, and unidirectional, – a one-way traffic, a one-way show:- Stan Anih (Ed.) 1987.

Lecturing method heavily relies on the teacher as the only source or transmitter of knowledge, ignoring the role and contributions learners can make. Even the lecturing method has some advantages:-

3.4.1 Advantages of Lecture Method

(i) It makes for time economy; the teacher can deliver much learning contents within a short time. Hence it is useful when there is aspiration to cover the syllabus.

(ii) In situations where classes are very large, as in most higher institutions, it may be the only effective way of teaching.

(iii) Even in mathematics, there are some topics that telling or delivery of a lecture type e.g. concepts that need giving definitions or describing e.g. defining different types of polygons; describing shapes etc

(iv) Teachers of Science do consider lecturing as the best method of opening up certain topics especially difficult ones.

The fact that lecturing method has some advantages show that it can help achieve certain specific educational objectives if it is well directed. For example, in large gatherings such as large classes, town gathering, mass campaign, church and mosques congregation, the method of teaching still found suitable to employ is lecturing.

3.4.2 Disadvantages of Lecture Method

These includes

(i) It is a passive method of learning and this is more often less effective than if the learners are also engaged in the learning process.
(ii) All learners are made to learn the same content at the same rate.
(iii) Learners are exposed to only the teacher's interpretation of content to be learnt.
(iv) Some times, learners do not have opportunity to ask questions, especially during a rush to cover the content to be learnt.
(v) Many lectures are dull; they do not make for an exciting atmosphere.

3.4.3 Example of Lecture (or Telling) Lesson

Topic Operation with directed Algebraic terms

Introduction

(i) 3a is the short form of 3 x a
So also – 3a is short for (-3) x a
(ii) 1 x P is long form of P
So also –p is short form of (-1) x p
(iii) Numbers whether positive or negative and algebraic terms can be multiplied together.

Examples: Teacher works the examples on board and explains the steps.

(i) $5 \mid (-2y) = (+5)x \ (-2) \times y$ – [Separate letters & numbers)
$= -(5 \times 2) \times y =$ [Combine the numbers in a bracket]
$= 10 \mid y = -10x y$

(ii) $(-4 \chi) \times (-3y) = (-4) \times \mid x \ (-3)x y$ [Separate figures & numbers)
$= (-4) \times (-3) \times \mid x y$ [Arrange numbers & letters together]
$= +(4 \times 3) \times \mid y$ [mult. numbers & letters separately first)
$= +12 \mid y$ [Combine your answer]
$= 12 \mid y$ [Plus sign may be eliminated]

The teacher may give one or two more examples, and he gives learners exercises to attempt.

ANSWER TO SELF ASSESSMENT EXERCISE 1

It is important that a teacher gets exposed to different methods of teaching. This is because such a knowledge or exposure will equip him with resources in teaching methods from which he can always draw upon when considering teaching different topics in mathematics. He will be able to select the method that is appropriate or suitable for the mathematical topic under consideration.

The following four things should be considered by the teacher when planning to use a particular topic. He should ensure that:-

(i) he understands the method very well
(ii) the method will be effective for the topic he wants to teach.
(iii) the method will help his learners to understand the concept he wants to teach them.
(iv) the method will afford his learners the opportunity to actively participate in the lesson. Where learners are passive participants their understanding of the topic cannot be guaranteed, and they may not be able to utilize the concept so taught in real life situation.

ANSWER TO SELF ASSESSMENT EXERCISE 2

Advantages of guided discovery includes the following

(i) It makes learners to participate actively in the lesson; they become major actors and actresses while the teacher only guides them.

(ii) Since learners make discovery of the concept to learn, they are likely to retain the knowledge learnt
(iii) Learners will be able to transfer the knowledge gained to real life usage.
(iv) Since learners work on their own to discover knowledge, it will help them to develop ability and courage to solve other life problems.

Disadvantages of Guided discovery

(i) Discovery method of teaching wastes time. This implies that the teacher should be prepared to give hints and proper direction to learners in order to minimize time spent.
(ii) There is a tendency for the classroom to be noisy under this method as learners interact with materials and with themselves.
(iv) It is not every learner that ends up making the expected discovery even with the guidance offered by the teacher. However, when majority of the learners have made the expected discovery, the teacher can use their discovery to lead others into the results through a rounding up class discussion.

4.0 CONCLUSION

The various methods of teaching to which you have been exposed in this unit has both their advantages and disadvantages. They also have relevant times that they may be used to meet specific educational objectives. It is important that you as a teacher be familiar with the different methods, their merits and demerits, as well as which may be used when planning a particular lesson to teach. This is particularly important because as a teacher plans a lesson he should plan the method to employ in teaching along with the planning.

5.0 SUMMARY

In this unit, you have been exposed to some method of teaching that can possibly be employed in the teaching of mathematics as at when appropriate. These include:

(i) The discovery approach of teaching
(ii) The group method of teaching and
(iii) The lecture method.

The laboratory and individualized approaches are treated separately in later units.

6.0 TUTOR MARKED ASSIGNMENT

(a) When will you as a teacher consider using group method of teaching in the teaching of mathematics?

(b) What are the advantages and disadvantages of group method?

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UNIT 2 LABORATORY APPROACH OF TEACHING MATHEMATICS

CONTENTS

1.0 INTRODUCTION

Mathematics has been labelled as one subject that is too abstract and not related to life; these factors have also been given as part of the reasons for students' poor performance and negative attitude towards mathematics. This has led to the quest for other method of teaching that would make mathematics both meaningful and enjoyable. The laboratory approach of teaching mathematics has been one method that serves this purpose. It is a method of teaching that is particularly suitable for the primary and junior secondary school levels of education

that every mathematics teacher should know and use. This unit presents you with that approach of teaching mathematics; it will bring life to your teaching, make the best of it.

2.0 OBJECTIVES

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

(i) Give the definition of laboratory approach of teaching mathematics
(ii) Relate the need and purpose for a laboratory approach of teaching mathematics.
(iii) Highlight the features of a laboratory approach of teaching mathematics
(iv) Prepare for and teach a laboratory lesson
(v) Relate the success of the method.

3.0 MAIN CONTENT

3.1 Laboratory Approach of Teaching Mathematics: Definition

The laboratory approach of teaching mathematics is a method of instruction that offers learners the opportunity to discover mathematical concepts through their active involvement in the learning process; the approach is that of learning by doing. From the stand point of Piaget's research, it has been found that this approach of learning mathematics is most suitable at the primary and junior secondary school levels. It is an approach whereby mathematical concepts are abstracted from investigations and manipulations of physical or concrete materials. This makes learning meaningful. For example, in teaching cardinal numbers in the primary school, children should be given experiences in the matching of numbers with objects. For instance in the teaching of '2', associate the number two with objects, e.g. 2 sticks, 2 pebbles, 2 books, 2 chairs, etc. Until the number property of 2 is understood and can be associated with 2 objects. This sharply contrasts with learning by simply memorising a sequence of sounds: "one, two, and three…," a method by which most of us were taught. The futility of such method is revealed by asking such a child to tell you how many objects you hold in you hand; most often he can't tell you, this is because he has merely memorized a sequence of sounds, he has not learnt to match number names with objects. Or say the metric system in the lower secondary schools; instead of allowing the students to carry out measurements in the different units, to discover the relationship and construct the tables themselves; they are made to learn and memorise these tables without being able to think in these systems, nor are they able to visualise what

these measurements stands for in practical life situation. Consequently they may not even know what situations demand their usage. For example, a student who is well versed in metric table may not know the distance represented by 100 meters or 2 kilometers, neither may he be able to gauge the distance from his home to school in meters or kilometers; he may not know how many liters of water an average drinking glass can hold; nor be able to guess the weight of an average man in kilogram. Worse still he may not even know when to use the meter, liter or gram based units. Such learning cannot be called true learning in the real sense of it. Real learning can only take place if children are allowed to abstract mathematical concepts from operations they perform on physical objects; this is what the laboratory approach of learning mathematics is all about. The techniques used in a laboratory strategy include discussion, discovery activities, model construction or even some directed teaching. Whatever the techniques used, the laboratory strategy focuses the learners' attention and activities on the relationship between mathematics and its real-world application.

3.2 The Need and Purpose of Laboratory Approach of Teaching Mathematics

A number of factors affecting the teaching and learning of mathematics today have made it necessary to consider the laboratory approach. Those factors include the following

3.2.1 The Problems of the Traditional Approach of Teaching Mathematics

The traditional approach describes the method whereby the teaching of mathematics is often text-book dominated, consisting of abstractions, learning of rules or formulae, tables and manipulation of symbols, where work are not generally related to the physical world.

Usually, under such method, instead of leading the students through discussion or practical investigation to discover the rules or formulae for themselves, the teacher usually gives the rules or the formulae for working.

For example he may simply give the information that:

e.g Area of a circle is πr^2

or in solving a quadratic equation of the form ax^2+bx+c, he informs the students that:

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

then ask the students to learn it by heart and master it. He may not even entertain questions on why it is so. He may then give few examples from

the text, illustrating the use of the formula and then assign the students to work further exercises on their own.

Studies have shown that where pupils have been drilled in basic facts and computational skills, pupils are usually not able to use such skills in relevant situations. For example when a senior primary pupil is faced with problems such as:

A boy gets ₦2 per day for working on a farm
He worked for 25 days on the farm, during the last holidays.
How much money did he get for working on the farm?

He may not be sure what to do, as to whether to add, subtract, multiply or divide until he is cued as to what to do.

When such happens, the teacher get disappoi nted and feel his efforts has been wasted, students get frustrated and think mathematics is difficult and can neither be learnt nor enjoyed. He feels like opting out of it at the slightest opportunity, and more often than not, he does. The laboratory approach then if implemented will go along way in solving major problems in mathematics learning. Student too will have a higher sense of achievement and improved attitude.

3.2.2 The Position of Mathematics in Our Present World

It is generally admitted that mathematics is an important and necessary subject for progress in any world. It is a subject that cannot be divorced from the world of Technology, which is a key to progress. It has been aptly described as the queen and servant of all subjects.

3.2.3 The Negative Attitude of Most Students Towards The Learning Of Mathematics

Although, mathematics holds such an indispensable position in the world's progress, yet it is well known that it is neither popular nor attractive to many students, right from the primary through to the tertiary institution. In the primary schools, it is the 'problem subject' of most pupils. It is not uncommon for boys and girls to make up their minds not to offer mathematics as they enter secondary schools (before it was made compulsory for students in the secondary school). In cases where they haven't already made up their minds to drop mathematics, it frequently happens that older student in the schools 'advise' junior or their favored students not to dare offer mathematics since it is "naturally difficult". Today, though it is made compulsory for students in

secondary school, yet most students perform poorly and pass out of the secondary schools with a failed result in mathematics.

One reason for this is the method of teaching employed. In many of our schools today, mathematics teaching is often textbook dominated, as discussed above. Since students live in a concrete world, it is not surprising then that they neither enjoy nor understand mathematics presented to them in a meaningless way.

The situation poses a challenge, and has led many educators and researchers to direct their attention to finding better ways of teaching mathematics which will not only increase mathematical achievement of students, but will also improve their attitude towards it.

3.2.4 Support from Psychological Research on The Learning Of Mathematics

Some psychological researches undertaken in the quest to know the best approach of teaching and learning mathematics, have come to support the practical or the activity approach, which in essence is the laboratory approach.

Piaget for example, who is well known for his research on the stages of intellectual development of children, supports the laboratory approach of teaching mathematics.

Zoltan Dienes, a mathematician and psychologist together with Michael Holt have this to say:

> "Research over the past twenty years has made it possible at least to sketch in the basic principles by which learning, particularly of maths, can be made easier and more fun for the clever and ordinary alike, and even for the gifted too. There has been a growing conviction that youngsters learn best through activities and games."

George Polya, a mathematician and Teacher trainer puts it this way:

> "For efficient learning, an exploratory phase should precede the phase of verbalization and concept formation and eventually, the material learned should be merged in and contributes to the integral attitude of the learner. This is the principle of consecutive phases."

There is therefore concrete evidence from psychological research supporting the laboratory approach of teaching mathematics.

SELF ASSESSMENT EXERCISE 1

Why do we need the laboratory approach of teaching mathematics as a method to consider for use in our mathematics classroom?

3.3 Features of a Laboratory Approach of Teaching Mathematics

3.3.1 Class Organisation and Arrangement

Laboratory work is usually given through assignment cards in which problems to investigate are written. The problems usually require using some of the materials in the mathematics laboratory for performing activities such as measuring, cutting, making models, comparing, sorting and questioning.

Such assignments may require that students work individually or in groups. Working in groups provides opportunity both for first-hand experience and for discussion of the problem.

Since learning involves carrying out various activities and experiment, sitting arrangement is usually different from that of a conventional classroom. Chairs and tables are to be arranged so that children can sit according to their working groups and also have free access to the working materials. A more permissible classroom atmosphere exists so that children can freely move about and discuss their problems with one another.

3.3.2 Learning Materials

For effective work to be carried out in the laboratory setting, a lot of mathematical materials would be needed. They should be such that children can see, handle, measure, etc. to develop mathematical ideas.

Materials for primary level can include, wooden blocks, dried beans or peas, match boxes, counting sticks, bottles tops, counting frames, abacus, clean and empty tins, bottles, glass jars, paper of all kinds cardboards, string, rope, cotton, thread, tape, rubber band, nails, razor blade, scissors, etc.

Materials for measurements include; balance scales, weights, rulers, meter stick, tape measures, micrometers, protractors, compasses, stop watches, clocks and plastics containers of various sizes.

Materials for secondary schools include; some of the ones mentioned above and also the following; garboards, centimeter cubes, graph-and grid-sheets, surveying equipment, mosaic tiles, Dienes blocks work cards, student's project folders, and so on.

While most of them can be obtained or produced locally, some of them may not be available in Nigeria, but they can be ordered from abroad. As can be seen from the list, desks, textbooks, blackboard and chalk are no longer all that need to be provided!

3.3.3 Books

In the laboratory approach to learning mathematics books are still needed, not as the main pilot of the programme but as a resource material, just like any other materials in the mathematics laboratory. They are not the bases for learning as is the case in conventional classroom. After students have abstracted mathematical ideas from objects at the concrete operational level, books or worksheets of duplicated problems can then be used as sources of problems for practices. But more often, problems in a mathematics laboratory-learning situation are in form of assignment cards or worksheets.

3.4 Laboratory Lessons and Some Samples

For success and effectiveness, a laboratory lesson needs very careful planning; in fact its preparation in most cases is more demanding (but it is more rewarding) than a regular classroom lesson.
The teacher has to ensure that all materials needed for a particular lesson are ready before the lesson begins. Some of the materials may be ready-made, others may have to be made locally by the teacher, (sometimes together with his students). Such materials usually include guide – or work-sheets, and other materials that may be needed for the lesson.

Guide sheets should include:

(i) Statements of objectives of the lesson
(ii) Necessary instructions to be given to students
(iii) Exercise to evaluate the achievement of the objective stated.

In a laboratory lesson, the teacher is just a guide or a supervisor. He gives the necessary instructions and provides materials needed for the

lesson. He ensures that there is enough space for the activities, maintains orderliness while work goes on and he goes around the class to offer help to individuals or helps answer questions that may arise. He tells his class when they should start cleaning up and make sure that all equipment is returned to its normal storage place. The following is a procedure used in preparing a laboratory lesson.

3.4.1 Procedures for a Laboratory Lesson

1. The preparation of guide sheets is essential, and should be made up in such a way that pupils know what they are to investigate, and the materials they need.
2. Ensure that all equipment and materials needed for the lesson are ready before the lesson begins – guide sheets and such materials as would be needed for the particular lesson.
3. The laboratory should be set, comfortable seats and table for students, availability of water for construction and washing purposes, adequate space for the work to be done, either in groups or as individuals.
4. The students too must be prepared to work and assume full responsibilities for laboratory work e.g. working independently, caring for apparatus, sharing and working together when necessary, ready to do cleaning up and to help others when necessary.

SELF ASSESSMENT EXERCISE 2

Enumerate the procedure for a Laboratory Lesson

3.4.2 Samples 1

Weight Measurement in Metric table

Apparatus: Bathroom weighing scale; weighing scale, graduated in grams, metal weight equivalents to milligram, centigram, grams, kilogram etc. Your maths textbook, a bucket of water, etc.

I. Group Activity: Feel the heaviness of each of the ‘weights’ by carrying them in your hand. Weigh each of the weights on the scale and record their weights. Guess the weight of the following, then weight them and record their weights.
   (1) Your mathematics text-book.
   (2) The bucket of water when full and when empty.
   (3) The biggest student in your group.

(4) The smallest student in your group.
(5) Yourself

II Using the balancing scale and the 'weights' balance, record the following weight relations:

?	Milligram	=	1 centigram
?	Centigram	=	1 decigram
?	Decigram	=	1 gram
?	Grams	=	1 Dekagram
?	Dekagram	=	1 Hectogram
?	Hectogram	=	1 Kilogram

What do you notice?
What are the similarities between this table and the one for length?

III Answer the following questions:

1. In what unit is weight measured in metric systems?
2. Write the following in grams
   3000 milligrams (mg.)
   400 decigram (dg.)
   1/10 of a kilogram (kg.)
   ½ of a Dekagram (dg.)

N.B. It is assumed that students have done metric length measurement before this lesson. Also, a class discussion should have been had before this lesson. In the discussion the metric length measurement should have been revised. The meaning of the prefix, mili, centi, deci, deca, hecto and kilo revised. Also the students should have been told that gram is unit of measurement for weight.

The next sample had been presented earlier in the unit on motivation, but it is still represented here as it also adequately illustrate a laboratory approach.

3.4.4 Sample II

Class: JSS II (Sec. Sch.)

Duration: 70 mins. (Double Period)

Topic: The sum of angles in a triangle

Aim: Students will know and be able to apply the fact that the sum of angles in a triangle is 180^{o}

Apparatus: (1) Paper triangle cut outs

(2) Work sheets

Previous Knowledge: Student has done construction work.

Instruction: Perform the following exercises and answer all questions that are asked.

I. Construct triangles ABC with the following dimensions:

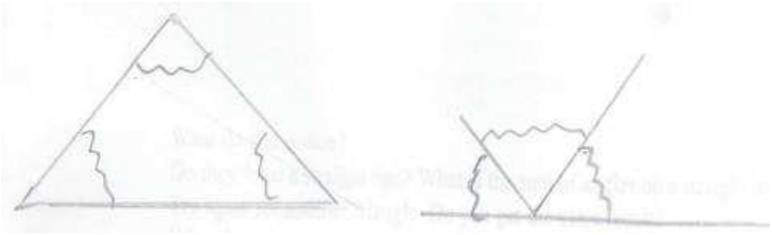
1.	AB = 5cm	BC = 4cm	<B = 50o
2.	AB = 6cm	CA = 2.5cm	<A = 106°
3.	BC = 4cm	CA = 7cm	<C = 78°
4.	CA = 5cm	<A = 37°	<C = 90°
5.	BC = 6cm	<B 116°	< C = 10°
6.	AB = 7cm	< A = 35°	<B = 64°

II Measure angles of the triangles constructed and complete the following table:

Triangle	**1st angle**	**2nd angle**	**3rd angle**	**Sum of the three angles**
1				
2				
3				
4				
5				
6				

What did you get for the sum of the 3 angles of each of the triangle?

III Take a piece of paper and cut out a triangle. Tear of the vertices and place the angles together as shown below.



What do you notice?

Do they form a straight line? What is the sum of angles on a straight line? Try again for another triangle. Do you get the same result? What does this show you about the sum of angles in a triangle?

The sum of the 3 angles of any triangle is.....

IV. Attempt the following exercise

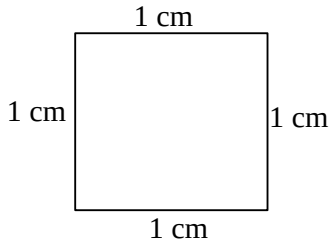
The table below shows 2 of the angle (measured in degrees), of triangle ABC for some different triangles. Find the missing angle in each case.

	Angle A	**Angle B**	**Angle C**
1	25	50	
2	41o	79	
3	102		23
4	90	37	
5		67	74
6	82		28
7	66	77	
8		23	18

3.4.5 Sample Lesson

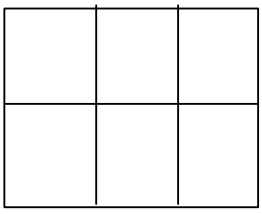
Class: V or VI (primary) or as a remedial lesson in form 1 (sec.)
Duration: 35 mins.
Topic: Area of rectangular polygons.
Aim: Pupils will be able to find area of any rectangular polygon.

Instruction:



(This is a square centimeter Teacher discusses meaning of Length and Breadth of a rectangle).

You can find the area of a plane figure by counting the number of square units in it. Our unit here is a square centimeter (sq. cm).



The area of this rectangle is 6 square centimeter i.e. 6 square centimeters.

I. Now find the area of the following rectangles by counting the number of square centimeters.

II. Now complete the following tables using the answers obtained.

Number of Problems	Length of Rectangle	Breadth of Rectangle	Area of Rectangle
Example	3cm	2cm	6 square cent.
1	4cm	3cm	
2	5 cm	3cm	
3	5cm	4cm	
4	6cm	4cm	
5	3cm	3cm	
6	4cm	4cm	

III. What do you notice? To get the area of a rectangle, what do you do with the length and breadth of the rectangle?

IV. Now find the area of the following rectangle:

(1) Length = 9 cm
Breadth = 4 cm
Area =

(2) Length = 7cm
Breadth = 3cm
Area =

(3) Length = 8mm

(4) Length = 2 1/2m

Breadth = 3mm
Area =

Breadth= 3 1/2m
Area =

(5) Length = 5mm
Breath = 3mm
Area =

(6) Length = L cm
Breadth = B cm
Area =

So in general, when the length of a rectangle is L, and Breadth is B, Then the area is.....

3.4.6 Sample IV

Class: Class VI
Duration: 70 mins. (Double Period)
Topic: Multiplication of positive and negative integers.
Aims: Students will be able to find products of integers when:
(1) One is positive and the other is negative
(2) The two integers are negative

Previous knowledge: (i) students can multiply two positive integers,
(ii) Students understand the commutative property of multiplication and addition.

Apparatus: Work sheets
Instruction: Carry out the following exercise and answer the questions that go along with them: (N.B. a here means '-a')
Step I: Write answers to the following multiplication:

1 (a) 4 x 4 = 16
4 x 3 = 12
4 x 2 = 8
4 x 1 = 4 (N.B.) the written are assumed supplied by the students.
4 x 0 = 0
4 x –1 =?
4 x –2 =?
4 x –3 =?

Now what do you notice about the number you multiply by 4 in each case? Are the numbers decreasing or increasing? By how much do they decrease at a time? Now look at you answers – are they decreasing or increasing? As you decrease the multiplier by 1? Study the pattern; following the same pattern, what should the answer be after zero? What again is the answer after that? Complete the exercise.

II. Now study your answers

(a) When the two numbers multiplied are positive in the above, are your answers positive or negative?

(b) When one of the numbers is positive and the other is negative, is your answer positive or negative?

(c) What does that suggest about the product of a negative and positive number?

(d) Then in general what is (a) x (-b) =

1(b) Do the following:

3 x (-4) =
5 x (-2) =
(-3) x (4) =
6 x (-6) =
(-5) x 3 =
10 x (-5) =

III Now do the following and study the pattern of your answers

2 (a) -3 x 4 = -12
-3 x 3 = -9
-3 x 2 = -6
-3 x 1 = -3
-3 x 0 = 0
-3 x –1 =?
-3 x –2 =?
-3 x –3 +?

Now study your answers. Are your answers increasing or decreasing?

As you multiplier decreases by 1, by how much does your answer increase each time? Then what answer must follow '0'?

What again follows that?

Then complete the exercise.

IV. **Study your answers again**:

(a) When one negative and one positive integer are multiplied together in the above, is your answer positive or negative?

(b) When the two numbers multiplied together are negative numbers, is your answer negative or positive?

(c) What does that suggest about the product of two negative numbers?

(d) Then in general what is (-a) x (-b)?
(-a) x (-b) =

3 (a) Now do the following
-3 x –4 =
-3 x –8 =
-5 x –4 =

-6 x –2 =
-12 x –5 =

3 (b) Attempt the following exercise:
3 x –9 =
13 x –4 =
-15 x –4 =
-20 x –5 =
-7 x 7 =
-8 x 6 =
-3 x –20 =
15 x –3 =

SELF-ASSESSMENT EXERCISE 2

Write down the procedure for a laboratory lesson.

3.5 The Success of the Method

In order to assess the effectiveness of the method. A number experimental study has been undertaken. One of such experiment was conducted by (1) James H. Vance (University of Victoria, British Columbia, Canada) and Thomas E. Kieren (Department of Secondary Education, University of Alberta, Edmonton 7, and Canada). This particular experiment was on the comparison study of mathematical achievement of students in junior classes in Secondary Schools under different methods of teaching. Three different method of teaching were used:

(i) The mathematics laboratory method.
(ii) The class discovery method (it should be noted here that a discovery method does not mean a laboratory method, though all laboratory methods are discovery method).
(iii) Traditional method.

Of the three groups, the achievement of the group for which the laboratory approaches was the highest. It was also found that the laboratory group appeared to have a slightly better attitude towards mathematics than the other group – when measured by a standard attitude instrument.

The above report is an indication of how tremendous the mathematical achievement of our students can be under this strategy, and particularly how the attitude of students towards mathematics can become positive. Mathematics, our educators are therefore urged to take up the challenge presented by the negative attitudes of our students under the chalk-talk approach of teaching mathematics. Their attitude towards this

indispensable subject can be made more positive. Our students can learn and enjoy mathematics and we should let them be aware of this. Let us be concerned enough about the mathematical achievement of our students as to encourage teachers to experiment and implement this new method that have proved successful. The issue that is being put across in this approach of teaching mathematics is summarised in the following Chinese saying:

"I hear and I forget
I see and I remember
I do and I understand"

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

The need for laboratory approach as a method to consider for used in our mathematics classroom. A number of factors affecting the teaching and learning of mathematics necessitate the need for laboratory approach; these factors include:-

(1) The set back from the use of traditional approach. Traditional approach is often characterised by the use of text-books, it consists of abstractions and manipulation of symbol which are not related to the real world.

(2) The negative of most students towards the learning of mathematics. It must be indispensable position in the world's progress, yet it is well-known that is neither popular nor attractive to many students.

SELF ASSESSMENT EXERCISE 2

Procedures for a laboratory lesson include the following:

(i) The preparation of guide sheets is essential and should be made up in such a way that pupils know what they are to investigate.

(ii) Ensure that all equipment and materials needed are ready before the lesson.

(iii) The laboratory should be set, comfortable seats and table for students.

(iv) The students too must be prepared to work and to assume full responsibilities for laboratory work.

4.0 CONCLUSION

When learners are given the opportunity to learn mathematics through an explorative and practical approach, they not only enjoy it but it also enhances their understanding of the concept to be learnt. This will also lead to better performance and positive attitude of learners towards mathematics. The laboratory approach is one method that helps learners in this direction. As a teacher, you should be conversant with this method and use it for your learners, or if a 'teacher of teachers' – then teach those who will be able to use it for their learner directly.

5.0 SUMMARY

The following are the highlights of the considerations of this unit:

(i) Definition of the laboratory approach of teaching mathematics.
(ii) The need and purpose of laboratory approach of teaching mathematics
(iii) The features of laboratory approach of teaching mathematics
(iv) Samples of laboratory lessons were given and
(v) The success of the method was related.

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

The need for laboratory approach as a method to consider for used in our mathematics classroom. A number of factors affecting the teaching and learning of mathematics necessitate the need for laboratory approach; these factors include:-

(1) The set back from the use of traditional approach. Traditional approach is often characterised by the use of text-books, it consists of abstractions and manipulation of symbol which are not related to the real world.
(2) The negative attitude of most students towards the learning of mathematics. It occupies an indispensable position in the world's progress, yet it is well-known that is neither popular nor attractive to many students.

SELF ASSESSMENT EXERCISE 2

Procedures for a laboratory lesson include the following:

(i) The preparation of guide sheets is essential and should be made up in such a way that pupils know what they are to investigate.

(ii) Ensure that all equipment and materials needed are ready before the lesson.

(iii) The laboratory should be set, comfortable seats and table available to students.

(iv) The students too must be prepared to work and to assume full responsibilities for laboratory work.

6.0 TUTOR MARKED ASSIGNMENT

What is a laboratory of teaching mathematics?
Why will you recommend this approach of teaching mathematics?

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UNIT 3 INDIVIDUALIZED INSTRUCTION AN EFFECTIVE APPROACH OF TEACHING MATHEMATICS

CONTENTS

1.0 INTRODUCTION

In the previous units, you have learnt about, instructional aids and how to use them to enhance mathematics teaching. You have also learnt about different methods of teaching mathematics. In addition to this is the unit on Laboratory approach of teaching mathematics. In this unit, you will be exposed to individualized approach of mathematics. As a mathematics educator/teacher, you need to be conversant with various approaches of teaching mathematics. This is one major way to face the constant challenge of improving the performance and attitudes of our learners towards the learning of mathematics.

2.0 OBJECTIVES

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

(i) State the persistent concern for the teaching and learning of mathematics
(ii) Explain the meaning of Individualized Instruction
(iii) State the relevance of Individualized Instruction in the mathematics classroom
(iv) Enumerate the characteristics of a reluctant learner
(v) Highlight the approaches to individualizing instruction
(vi) Outline the positive and negative aspects of individualized instruction

3.0 MAIN CONTENT

3.1 A Persistence Concern for the Teaching And Learning Of Mathematics

One major concern of mathematics educators and teachers centers on how to make the teaching and learning of mathematics more meaningful and effective as well as how to make it related to the needs, interests and abilities of learners. However, to actualise these intentions still present an enormous challenge because it is evidently clear that the learning of mathematics has still not been successful with many learners. There is therefore a continuous effort geared towards identifying effective instructional modes in the teaching and learning of mathematics. It has for long been recognized that an effective instruction is a function of many variables involving both the learner and the learning; which takes into consideration individual differences that exist among learners.

One such effort towards making mathematical learning more effective for all learners is expressed in the phrase ‘individualized instruction’. The main thrust of individualized instruction lies in accepting learners as individuals whose individualities, as it affects their learning, should be considered in planning instruction. On this note, individualized instruction is defined below.

3.2 What is Individualized Instruction?

Simply put; Individualized Instruction may be defined as a mode of instruction in which the teacher attempts to make provision for individual learner’s differences. A typical individualized instruction setting has the following features:

(i) Pre-test or diagnostic testing:- Individualized instruction requires a frequent diagnostic testing of an individual learner. This is to enable the teacher to know what each learner has learnt or has not learnt, this will enable the teacher to guide the learner appropriately into what to learn next.

(ii) Prescription lesson:- On the basis of the results of diagnostic or pre-test results, the teacher will direct each learner either into in-depth topics if the learner proves to have understood the previous section of the concept. If however the pre-test results show inadequate understanding,; the learner will be directed into doing corrective activities that will help him to master the topic under consideration.

(iii) Post-test:- After going through the allotted material to work upon or study, the learner again takes a post study test to be able to know how he fared in the study. If the test-results shows that he understands, he can move on to the next topic; but if otherwise, he may go into more corrective work independently or with the assistance of a teacher.

(iv) Frequent monitoring:- This is the main feature of an individualized instruction. Frequent monitoring through various tests and teacher observation go on in order to know how the learner is faring. Usually, such monitoring enables the teacher to detect whether a learner has problems or is doing well. If he has problems, what are his problems, how may he be helped etc. It enables the teacher to help the learner individually and at his own level of needs.

From the foregoing, you would have noticed that, Individualized Instruction is associated with a type of classroom management that allows learners to progress independently through an ordered series of lessons.

SELF ASSESSMENT EXERCISE 1

What do you understand by Individualized Instruction?
List and discuss the main features of an Individualized Instruction.

3.3 The Relevance of Individualized Instruction in The Mathematics Classroom

The fact that individual differences exist among learners is a well-known phenomenon to all concerned with education. Indeed in a general

sense, no two individuals are the same; hence once a teacher has before him a set of learners – say up to two or more, he is faced with a challenge of which mode of instruction will effectively cater for the varying needs and background of his learners. Judging from a regular high rate of failure in mathematics at the School Certificate level, (Osibodu 1977) a high percentage of learners in a typical classroom setting can be classified either as reluctant learners – of mathematics (i.e. low achievers) or slow learners in mathematics. For any meaningful learning to be achieved, the nature or characteristics of the learners must be of the first consideration in preparing a strategy of instruction – including instructional materials to use. J. Foley, W. Jacobs, R. Bower, L. Smith, G. Burke and E. Basten (1971) identified some features of reluctant learners

3.4 Characteristics of Reluctant Learners

According to Foley & Co., reluctant learners generally

(i) are deficient in reading achievement and verbal communication
(ii) Have short attention span
(iii) Have poor attendance records
(iv) Learn at different rates of speed
(v) Need to experience immediate success and a feeling of worth
(vi) Do not respond to the traditional teacher
(vii) Are likely to drop out of school unless their interest can be engaged
(viii) Often have high potential (their meagre achievement is frequently due to lack of background and poor study habits)
(ix) Most often come from a low socio-economic background
(x) Prefer to work under fair and consistently imposed conditions
(xi) Learn well from each other.

More specifically with respect to mathematics they further identified that reluctant learner

(xii) Experience difficulty in abstracting and generalizing.
(xiii) Generally lack interest in mathematics
(xiv) Often feel that there is a stigma attached to being enrolled in a "basic" or "general" mathematics class
(xv) Vary in their mathematical deficiency' (one reluctant learner may be strong in an area in which another reluctant is deficient)

A study of foregoing list will convince any educator that 'everybody-come-along' or generalized approach of textbooks cannot make provision for the varying needs and background of the type of learners described above. Individualized approach of learning mathematics is a strategy of teaching that is intended to reach this category of learners. It is a strategy that provides for different learning rates and varying

mathematical deficiencies, while at the same time allows a learner with high potential to develop that potential.

SELF ASSESSMENT EXERCISE 2

Enumerate the characteristics of a reluctant learner.

3.5 Approaches to Individualizing Mathematical Instruction

Mathematical Instruction can be individualized in a number of ways. These include through the use of work cards, grouping, and individualized lessons and through the use of programmed text.

3.5.1 Work Cards

These are cards on which assignments are written for learners to work upon at their own pace and time. Using assignment cards, students can work either individually or in small groups of two or three.

Work cards can be used to write individual assignment for learners. Such assignment can be graded according to difficulty level. Sometimes, when a learner has completed an assignment given to a whole class he may be given related exercise on cards to keep him busy while others are still working on the initial assignment. Such extra work on assignment can be a little harder than the general ones if the learner is an above average learner.

Work cards can also be used to write investigation exercises for learners. Investigations are works carried out by learners individually or in small groups, for the purpose of discovering a mathematical formula or to arrive at generalizations.

The investigation assignment will be written in a planned step by step mode such that when the learners follow the steps correctly, he will arrive at the correct conclusion.

Also, instruction on what a learner should do can be written on work-cards i.e. the work to do is prescribed on the work card, and a learner can pick one that interests him to work upon.

Some Examples of work cards are shown below:

CARD A2

Supplementary Exercises **Topic: Expanding Algebraic expressions** **Instruction: Expand the following Algebraic expressions**			
1.	(p+q)(r+s)	2.	(a-b)(c+d)
3.	(a+3)(a+4)	4	(3p+q)(2-p)
5.	(c-2)(c+5)	6.	(w+x)(y-z)
7.	(y+1)(y-4)	8.	(2m+5n)(p-39)9.
9.	(x-3)2	10.	(x+2)2

Fig 1: Example of Supplementary Exercises Work Card

CARD S5

Supplementary Work **New General Mathematics** **For Junior Secondary Schools 2** **Page 49 Exercise 6c** **Nos. 1 to 5**

Fig. 2: Example of Instruction Work.

CARD I 4

Investigation on Multiplication with negative numbers.

Instructions:- Carry out the following multiplication and answer the questions that go with them:- NB

(a) First do the multiplication up to 3 x 0, then answer the questions

3 x 4	=	(i) Now what do you notice in your answers
3 x 3	=	(ii) Are they decreasing or increasing in value?
3 x 2	=	(iii) As your multipliers (i.e. column 2)
3 x 1	=	decrease by 1 in each case by how much
3 x 0	=	is your answer decreasing each time?
3 x –1	=	(iv) Following the same pattern what should
3 x –2	=	the answer be after zero?
3 x –3	=	(v) What again is the answer after that?
3 x –4	=	(vi) Complete the exercise

Now study your answers:

(a) When the two numbers multiplied are positive, are your answers positive or negative?

(b) When one of the numbers is positive and the other is negative, is your answer positive or negative.

(c) What does that suggest about the product of a negative and positive number?

(d) In general what is (a) x (–b)? a x (–b) =

Then do the following

3 x (–4) =
3 x (–2) =
(–37 x (4) =
5 x (–5) =
(–4) x 9 =

Fig. 3: Example of Investigation Work Card

3.5.2 Grouping

Grouping can also be used in Individualized Instruction approach of teaching mathematics. The phrase Individualized Instruction does not mean that learners always work individually or that the teacher-pupil ratio is always one. Learners can still work in groups of two, or more on the same material or activity with the teacher guiding.

Grouping is particularly relevant in situations such as

(i) At the initial stage of developing a new topic or concept; i.e. at the investigation stage, learners can work together towards arriving at a generalization or formula.

(ii) In situations where the number of available materials or apparatus are not enough to go round all learners; and yet it is important for everyone to have a chance to see, handle and use the materials,

then they can be divided in groups. The size of the group will be determined by the number of the apparatus available. In this way every learner will be able to interact with the limited materials in their groups.

3.5.3 Individual Lesson

Individual lessons can also be conducted through the use of assignment or work cards and programmed text. Under this strategy individual learners will pick up assignment cards and begin to work on their own. The same thing applies to work that has been set out on programmed text. The disadvantage of this mode however is that while it caters for individual differences, it looses out on the social aspect of education. This is because, in some cases of individualized programmes where programmed texts or instruction is mainly used, a learner may work a whole year all alone without help or interaction with fellow learners. This is socially not wholesome enough because at an age when it is becoming more and more difficult for people to find time to relate, education should be bridging the communication gap through fostering interchange between learners rather than eliminating the interaction that basically exist among them. In this regard, teachers should plan to ensure that learners work with fellow learners and the teacher as frequently as possible within each week.

3.5.4 Programmed texts books

The use of programmed text is another way of individualizing lessons in mathematics. The programmed texts are designed to present learning material to a reader in a series of short steps. The learning steps consist of brief exposition followed by a question or questions. Usually, the learner responds by writing the answer in a space provided. Following this the learner will compare his answer with those supplied in the book (these are usually provided in a separate page or hidden somewhere in the text). In this way the learner receives an immediate feed back on his progress. Some of the programmes are written in such a way that if the learner's answer is not correct, he will be directed (by the programme) to remedial work where he can learn what he has missed – this type of programme is called branching programmes. This form of question and answer process usually gets the learner to be deeply involved in the learning activity.

He is usually forced by the question to share responsibility for learning. In addition, as the learner reacts to each question, he is led to discover a generalization. As he also provides answers to the questions or solves

the problems, correct answers are reinforced and he is able to correct his mistakes immediately.

Programmed text books seem to be an ideal way of providing for individual differences at least theoretically. It affords the slow learners to work at his own rate, and the fast learner is not hindered. When a learner misses work through absences he can still make up what he missed. It also provides a good remedial work when necessary.

The disadvantage of the use of programmed text however is that when they are used too often, it can become monotonous for slow learners. They may not find it enjoyable to work independently day after day just writing answers to questions, especially if they have reading difficulty. At the same time, fast learners see the questions as being trivial and time consuming. However, when it is integrated into the overall learning programme, and used at regular intervals, they can be very useful as a way of providing purposeful variety, and of meeting individual needs. This not withstanding, it has been pointed out (Scopes P.G. 1973) that in some experimental schools, the whole mathematics programme is completely individualized.

3.6 The Benefits and Non-Benefits of Individualized Instruction

With the fore-going discussion on Individualized Instruction it is good to look at the benefits and non-benefits of the learning mode as there is no system without its good and ills. First the benefits of individualized instruction are given below.

3.6.1 The Benefits of Individualized Instruction

The benefits of individualized instruction includes the following

(i) It is very suitable for providing for individual needs and differences of learners.
(ii) It brings variety into the teaching/learning processes in the mathematics classroom.
(iii) It creates a positive atmosphere in the classroom since every learner works on the material with which he can be successful.
(iv) It enables learners to grow in their mathematical understanding at their own rate which makes it an important mode of instruction with a class that has a very wide range of achievement levels.
(v) It leads to improved learning. It has been observed (Graham M. Evelyn 1972) that “in many instances where individualized instruction was initiated, education has improved in quality”.
(vi) It enables learners to learn at his own rate. A slow learner is not unduly hurried and the fast learner is not unnecessarily held back.

(vii) It enables the learner to develop initiative and a spirit of self-reliance, independent thinking and action.

(viii) Individualized instruction sustains learner's attention and makes him to develop interest in the learning of mathematics. This leads to improved attitude towards mathematics, which is a most desired development in the mathematics classroom.

3.6.2 The Non-Benefits of Individualized Instruction

(i) It does not foster social relationship among learners especially where the individual mode of learners is used completely or too frequently. This is because a learner can work for a long time on his own without having interaction but a good plan by the teacher to ensure that a learner work with his fellows will curb this trend.

(ii) It may take more time than allotted on the time-table especially the investigation stage. This may be curbed by including at least one double period of mathematics lesson in a week on the timetable so that such period may be used for such investigation lessons.

(iii) The constant use of learning materials may incure additional cost to the school, or the educational authorities concerned. However, when such cost is compared with the record of failures under conventional method objectively, it may be seen that the cost of re-teaching these learners is greater than the cost of individualizing mathematics.

(iv) The need for constant testing both to diagnose and to assess, together with the need to keep record may make it more demanding for teachers, however this extra effort and time can be most rewarding by the joy of improved quality of learning and attitude of the learners.

ANSWER TO SELF ASSESSMENT EXERCISE 1

Individualized Instruction may be defined as a mode of instruction in which the teacher attempts to make provision for individual learner's differences. An Individualized Instruction setting has characteristics like diagnostic testing, prescription lesson, post-test and frequent motivation.

Main features of an Individualized instruction include the following

(i) Diagnostic Testing
(ii) Prescription Lesson
(iii) Post-test

(iv) Frequent motivation

These features are discussed below:-

(i) Diagnostic Testing

An individualized instruction requires a frequent diagnostic testing of an individual learner. This helps the teacher to know what individual learner has learnt or has not.

(ii) Prescription Lesson

Based on the results of diagnostic or pre-test results, the teacher will direct each learner either into in-depth topics if the learner proves to have understood the pre-test results show inadequate understanding, the learner will be directed unto doing corrective activities that will help him to master the topic under consideration.

(iii) Post-test

After going through the allotted material to work upon or study, the learner again takes a post study test to be able to know he fared in the study.

If the test-results show that he understands, he can move on to the next topics, but if otherwise, he may go into more corrective work independently or with the assistance of a Teacher.

(iv) Frequent Monitoring

This is the main feature of an Individualized Instruction. Frequently monitoring through various tests and teacher observation go on in order to know how the learner is faring. Such monitoring enables the teacher to detect whether a learner has problem or is doing well.

ANSWER TO SELF ASSESSMENT EXERCISE2

Characteristics of a reluctant learner include the following:-

(i) are deficient in reading achievement and verbal communication
(ii) Have short attention span
(iii) Have poor attendance records
(iv) Learn at different rates of speed
(v) Need to experience immediate success and a feeling of worth

(vi) Do not respond to the traditional teacher
(vii) Prefer to work under fair and consistently imposed conditions.

4.0 CONCLUSION

Individualized approach of learning has been presented here with a view to get you as a teacher and educational authorities acquainted with this mode of instruction which (although has been found to be rewarding) is not yet commonly practiced in our classrooms. At the same time, to challenge us to explore a mode that can bring improvement to mathematical learning and attitude to learners.

The challenge presented by poor performance and attitudes of learners in mathematics should stir a desire in us to try new methods and innovations. Commenting on the success of this mode of learning, Evelyn M. Graham (1972 P.15) pointed out that

> "Although there is no more panacea for teaching and learning, Individualized Instruction seems to be one of the most successful endeavors available to education".

5.0 SUMMARY

The highlight of the discussion in this unit includes the following:-

(i) Discussion on the persistent concern for the teaching and learning of mathematics.
(ii) Explanation of what Individualized Instruction is.
(iii) The relevance of Individualized Instruction in the mathematics classroom.
(iv) Characteristics of reluctant learners
(v) Approaches to Individualized Instruction and
(vi) The benefits and non-benefits of Individualized Instruction.

6.0 TUTOR MARKED ASSIGNMENT

Individualized Instruction has been described as an effective approach of teaching and learning mathematics.

(i) What are the benefits of this approach to the teaching and learning of mathematics?
(ii) What are the non-benefits?

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MODULE 4

Unit 1 Remedial teaching in Schools Mathematics Programme
Unit 2 Evaluation of Instruction in Mathematics teaching and Learning I
Unit 3 Evaluation of Instruction in Mathematical Teaching and Learning

UNIT 1 REMEDIAL TEACHING IN SCHOOLS MATHEMATICS PROGRAMMES

CONTENTS

1.0 INTRODUCTION

This unit will expose you to principles of conducting remedial teaching in mathematics with particular reference to primary mathematics. As pointed out in the introductory notes to this course as a whole; you may not directly be involved in teaching at the primary level , but you may be involved in training teachers that will teach at this level of education. It is therefore necessary that you get exposed to some of the concepts

that you will need to prepare others. Primary education is the foundation of our educational pyramid, and most mathematical learning problems that learners encounter begin at this level. Principles of remedial instruction are like a general tool that can be used to correct learners' problems in any mathematical concepts. Apart from this, the same principles can be adapted for use at secondary or even tertiary level of mathematics. So you need the principles. Be ready for an enjoyable reading.

2.0 OBJECTIVES

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

(i) Identify the need for Remedial teaching
(ii) Explain the meaning of Remedial teaching
(iii) Conduct diagnostic test
(iv) Tell the causes of poor performance
(v) Point out possible Instructional problems and suggested guidelines for remediation.

3.0 MAIN CONTENT

3.1 The Need for Remedial Teaching

Mathematics, though significant to the scientific and technological development of our nation, is one subject in which most students perform poorly. A look at students termly report sheets show this. This situation has been an issue of concern to mathematics educators and all those involved in education.

Educators generally and mathematics educators in particular are therefore consistently faced with a challenge to improve the situation. One way to do this is through remedial teaching.

3.2 Meaning of Remedial Teaching

Remedial Teaching (with reference to mathematics) is usually carried out with an objective to correct areas of misunderstanding or weakness or common errors that have been diagnosed among learners. When such corrective teaching is done, it usually makes pupils achieve better and consequently improve their attitudes towards the subject.

3.3 Preparation for Remedial Teaching

For effective remedial work the teacher needs to make some preparation as follows

3.3.1 Conduct a diagnostic test

To be able to prepare for the remedial teaching adequately, the teacher should know specific areas in the topics at hand that most learners do not understand which needs reteaching. In order to locate such areas, the teacher may need to conduct a test that cover every aspect of the topic been studied. Results of such a test will reveal areas not properly understood by learners. This will assist the teacher on the area to reteach or emphasize during the remedial teaching.

3.3.2 Understand Background Factors Responsible

Some times, there are some background factors that may cause poor performance in mathematics for some learners. Understanding of such factors by the teacher will enable him to help them further.
Such factors includes:-

(i) Learners who have little out of school experience e.g. little chances to solve problems or engage in mathematical activities outside school
(ii) Learners who get insufficient sleep, lack of food and good health will find it difficult to pay attention in the classroom (physical and emotional disturbance).
(iii) Learners who absent themselves from school continuously. This makes them to miss many new steps and topics taught in school, which in turn may lead to failure or poor performance.
(iv) Consistently transferring schools also has negative effect on a learner's performance especially if the syllabuses and procedures in all schools are not uniform.
(v) Automatic promotions from one class to another without having understood well mathematical principles and concepts learnt at the previous level often results in failure later.
(vi) Poor teaching methods employed by a teacher also contribute to poor performance in mathematics.
(vii) Also since mathematics demands a considerable amount of general intelligence for one to succeed, factors that negatively affect general intelligence can hinder mathematical attainment e.g. a mental defect sustained through injury or due to inborn causes will lead to poor achievement.
(viii) Poor memory: this is a common weakness of the backward child.

SELF ASSESSMENT EXERCISE 1

What kind of background can lead to poor performance in mathematics for a leaner?

3.3.3 Characteristics of the Backward Learner

Just as it is useful for the teacher to know factors that cause poor performance in mathematics, it is equally good to know some characteristics of the backward learner.

It has been noted that backward learners in mathematics have a low opinion of their worth (NCTM, 35th year book IX). Such pupils need encouragement so as to be able to value their worth as learners of mathematics.

A study of the written work of such learners usually show frequent occurrence of some errors, incorrectly written problems, wrongly copied problems or problems frequently left unanswered.

Their lack of interest in the subject is usually shown on their mathematics exercise books – which are usually dirty, poorly cared for, with missing or torn pages.

During dictation, it usually takes a backward learner a long time to write a dictated problem. He may ask the teacher to repeat the problem again and may end up writing a different problem altogether. Sometimes the backward learner just writes down what number that comes to his mind as an answer to a particular problem. The pupil may become shy and confused, may simply repeat what he knows as answer or may finally keep silent. When a pupil displays this kind of behavior, the teacher should not attempt to ask him to explain his procedure; he should just note his problem and give him personal help.

SELF ASSESSMENT EXERCISE 2

What are the characteristics of a backward learner?

3.4 Possible Instructional Problems And Suggested Guidelines For Remediation

The following are some common errors that teachers can expect backward learner to make; along with them are suggested guidelines for remediation.

(1) When diagnostic test results and other observation show that

(i) There is inadequate mastery of basic facts, then the following remedial measures can be adopted.

(a) Let the basic facts be retaught using concrete materials and the number lines.

(b) At the early stage, use words for number instead of writing symbols.

(c) Write frequent drill and reinforcement using variety of games and individual drill.

(2) When the pupils have difficulties with carrying e.g. recording both digits in units column as in the following example.

(i)
$$\begin{array}{r} 9\ \ 6 \\ +\ 2\ \ 8 \\ \hline 11\ 14 \end{array}$$

(ii)
$$\begin{array}{r} 1\ \ 3 \\ +\ 1\ \ 9 \\ \hline 2\ \ 12 \end{array}$$

You may use the following remedial guidelines:

(a) Allow learners to use concrete objects along with paper and pencil exercises.

(b) Review place-value and expanded notation.

(c) Label columns as T – tens, U – units.

(d) Use the ideas of re-grouping and counting.

(3) When pupils have problems in subtracting e.g. he always subtracts the smaller number from the bigger number regardless of the placement, e.g.

$$\begin{array}{r} 6\ \ 5 \\ -\ 2\ \ 8 \\ \hline 4\ \ 3 \end{array} \qquad \begin{array}{r} 30\ \ 4 \\ -\ 12\ \ 1 \\ \hline 22\ \ 3 \end{array}$$

Use the following remedial guidelines

(a) Use concrete materials.

(b) Use the idea of expanded notation, regrouping and renaming.

(4) When pupils have difficulties with zero; e.g.

$$\begin{array}{r} \ \ 1 \\ \hline 4\,|\,40 \end{array}$$ - the last zero is left out.

$$\begin{array}{r} 12 \\ \hline 5\,|\,510 \end{array}$$ – the remedial zero is left out i.e. in the answer.

Use the following remedial guidelines

(a) Assist learners to estimate quotients especially the number of places.

(b) Review division with zero.

3.5 Suggestions for Successful Remedial Instruction

The following suggestions will be found useful for the teacher in conducting remedial lessons.

(1) To help children gain understanding on new concept.
(a) Make liberal use of concrete manipulative and investigative experience with objects.
(b) Let the course be easy at first.
(c) Let initial problems in the early assignment be easy to ensure some measure of success.
(d) Ensure the children are ready for the new concept by providing a good review of needed concepts and skills.
(ii) In teaching new skills show learners smaller "dose" of practice at the beginning and at frequent intervals. Continue this over a long period of time.
(iii) Show interest in low achievers by providing motivational problems or games at the introductory stages.
(iv) In your teachings speak slowly, clearly and simply, to enable the slow learner understand exactly what is expected of him.
(v) Use illustrations and show objects whenever possible.

To conduct effective remedial lessons you the teacher should bear in mind that:-

(i) In teaching new concepts you begin with simple problems and later go to more difficult ones.
(ii) Use various concrete objects to build up new concepts.
(iii) Be sympathetic towards the weak learners, choosing new words carefully so as to build confidence in the learner and motivate him – this will enable him to attain a satisfactory level of achievement.
Your methods must be learner-centered, individualized and directed towards the learner's area of weakness in mathematics.

3.6 Some Sample Remedial Instruction

The following two lessons will illustrate one of the ways remedial lessons may be conducted, using a discovery approach.

3.6.1 Remedial Lesson 1

Problem: - Pupils have not got mastery of basic multiplication facts.
Objective: - To help pupils to gain proper understanding of and be able to multiply with one digit numbers.
Apparatus: -Distributes to each child seeds or stone for counting.
(ii) Activity sheets or guide sheets for each child are prepared by the teacher.

Procedure:-

Step I: - Introductory activities

Teacher puts the counting materials (say stones) on the desk at one end of the room. He then calls a learner and asks him to bring him 3 stones. **Teacher:** Go again and bring another 3. "Go again and bring another 3". Then he asks the class. How many times did he go? 'Three times' (3 times is written on the blackboard).

"How many stones did he bring each time?"
"Three". The blackboard now read '3 times" .3'
'And how many have we altogether?'
The learners count in threes and say 'nine'.
So we have '3 times 3 makes 9'

This process is repeated for the following examples
2 times 4 make 8
4 times 5 make 20

Step II: - The 'zero fact' is also introduced in a similar way:- A learner goes to the desk 4 times and bring nothing back each time; "How many times did he go? – "4 times" 'What did he bring back each time?' – Nothing. 'What has he got altogether?' – 'Nothing'. And the blackboard work looks like this:

4 times 0 makes 0
2 times 0 makes 0
3 times 0 makes 0 etc.

The 'one fact' is introduced similarly to give
1 times 1 makes 1
3 times 1 makes 3
4 times 1 makes 4 etc

Step III:

The teacher then introduces the sign 'X' to mean the same as 'times', like the other signs children have known e.g. + for 'add' and '=' is introduced to mean makes. The above work is then re-written as:-

3 x 3 = 9	4 x 0 = 0	1 x 1 = 1
2 x 4 = 8	2 x 0 = 0	3 x 1 = 3
4 x 5 = 20	3 x 0 = 0	4 x 1 = 4

Step IV

After the above activities, the children are then asked to use their own counting materials to do the following exercises.
Write the following multiplication and their answers:-

(a) e.g. 1 x 0 = 0
2 x 0 =
3 x 0 =
4 x 0 =
5 x 0 =

(b) 1 x 1 =
2 x 1 =
3 x 1 =
4 x 1 =
5 x 1 =

(c) 1 x 2 =
2 x 2 =
3 x 2 =
4 x 2 =
5 x 2 =

(d) 1 x 3 =
2 x 3 =
3 x 3 =
4 x 3 =
5 x 3 =

3.6.2 Remedial Lesson 2

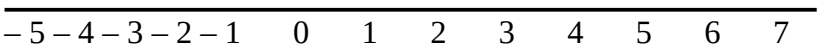
Problem: - Pupils have problems in subtracting bigger number from smaller ones.

Objective: - To assist pupils to be able to subtract bigger number from smaller ones.

Apparatus: - Number line, chalk and chalk board.

Introduction: - Teacher discusses the extension of number line to zero and negative numbers and their names. He also reminds that subtraction is always given by counts to the left on the number line.

Instruction:- Teacher says:- 'Using' the number line, it is possible to subtract bigger numbers from smaller numbers. E.g. 2 – 4



The subtraction 2 – 4 means: from 2, count 4 to the left; the arrow shows this. 2 – 4 = – 2

Do the following subtraction using the number line; then write down the answers:-

3 – 5 =
5 – 9 =
2 – 3 =
1 – 5 =

0 – 4 =
4 – 9 =
16 – 17 =
4 – 10 =

What do you notice in your answers when bigger numbers are subtracted from smaller numbers? The answers usually carry negative numbers before the figure.

(b) Can you see a way of subtracting bigger numbers from smaller numbers without using the number line?

Yes – by subtracting the smaller number from the bigger and put '–' before the figure.

(c) Now do the following without using number line.

6 – 8 =	3 – 2 =
5 – 9 =	12 – 13 =
0 – 6 =	10 – 18 =
9 – 10 =	5 – 10 =
7 – 12 =	20 – 30 =

Can you now subtract any bigger numbers from smaller numbers

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

Background that leads to poor learners' performance in Mathematics

There are various background factors that may cause mathematical poor performance for some learners. Such factors includes:-

(i) Learners who have little chances to solve problems or engage in mathematical activities outside school.
(ii) Learners who get insufficient sleep, lack of food and health will find it difficult to pay attention in the classroom. (Physical and emotional disturbance)
(iii) Constantly transferring schools also has negative effect on a learner's performance especially if the syllabuses and procedure in all schools are not uniform.
(iv) Learners who absent themselves from school continuously, this will make them to miss many new steps and topics taught in school which consequently leads to failure or poor performance.

SELF ASSESSMENT EXERCISE 2

Characteristics of a Backward Learner include the following:-

(i) Backward learners in mathematics have a low opinion of their worth. They have a low self esteem and do not value their worth.
(ii) Backward learners usually show frequent occurrence of some errors, incorrectly written problems or wrongly copied problems.

(iii) They show lack of interest in the subject as their mathematics exercise books, textbooks are usually dirty and with torn pages.
(iv) It usually takes a backward learner a long time to write a dictated problem. He may ask the teacher to repeat the problem and may end up writing a different problem altogether.

4.0 CONCLUSION

With a continuous increase in the number of pupils in the primary school especially with the implementation of UBE, the number of low-achievers in mathematics will increase. To improve this situation, there is need for a remedial programme to cater for mathematical-low-achievers in our schools. The plea goes to teachers to use all available resources, techniques and strategies at their disposal to assist the learners who need remedial work. "It is hoped that with appropriate methods of presentation, a sympathetic attitude and suitable material aids and right motivational techniques based on individual needs many of the learners disabilities will be eliminated." (Mshelia 1976)

5.0 SUMMARY

The following are the major highlights of what has been discussed in this unit:-

(i) The need for remedial teaching in our school programmes has been shown
(ii) The meaning of remedial teaching has been given
(iii) How to prepare for remedial teaching has been highlighted
(iv) Possible instructional problems and suggested guidelines for remediation was given
(v) Suggestions for successful remedial teaching was offered and
(vi) Sample remedial teaching was given.

6.0 TUTOR MARKED ASSIGNMENT

(a) What do you understand by remedial instruction?
(b) What steps will a teacher take in order to conduct a successful remedial instruction?

7.0 REFERENCES/FURTHER READINGS

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UNIT 2 EVALUATION OF INSTRUCTION IN MATHEMATICAL TEACHING AND LEARNING I

CONTENTS

1.0 INTRODUCTION

In this unit, you will be exposed to evaluation as an integral part of mathematical teaching and learning, you will learn about its purpose, its importance and the techniques of evaluation in the mathematics classroom. Have a pleasant study time.

2.0 OBJECTIVES

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

(i) Explain in your own words the meaning of evaluation
(ii) State the purpose of evaluation
(iii) Outline the types of evaluation
(iv) List the techniques of evaluation
(v) Differentiate between types of techniques

3.0 MAIN CONTENT

3.1 Meaning of Evaluation

With regards to mathematical instructions, evaluation is the means of assessing the effectiveness of the work done by the teacher as well as the level of understanding attained by the learners. (Grolund, 1976) cited

in Ezike and Obodo, 1991) defined evaluation as a systematic process of determining the extent to which instructional objectives are achieved by the students.
According to him the later definition implies two issues as follows:

(i) Evaluation is a systematic process
(ii) Evaluation always assumes that instructional objectives have been identified.

Hence, unless the instructional objectives had been previously identified, it will not be possible to determine the type and the extent to which learning has taken place. Therefore, evaluation is comprehensive and more inclusive than measurement. While measurement is limited only to quantitative description of learners' behavior i.e. it assigns numbers to observations or testing done on learners only; evaluation on the other hand includes both qualitative and quantitative description of learners' behavior as well as value judgment concerning the desirability of that behavior. Indeed, evaluation may not be based on measurement, and where it does, it goes beyond mere assignment of numerical values.
In mathematical instruction, evaluation is mainly concerned with assessing the extent to which mathematical understanding are achieved.

3.2 The Purpose of Evaluation in Mathematical Learning and Teaching

Evaluation should be seen as an essential ingredient for effective mathematical teaching and learning. Its main purpose is to provide feedback to all stakeholders in this enterprise. This group includes the teacher, the learner, the parents, the school as a system, etc. and also to motivate learning.

3.2.1 Feedback to the Teacher and Learners

Every teacher need to know how effective his teaching has been. For example, after the completion of a lesson, a topic, a unit or even a whole course of mathematics programme he may be interested in finding out the effectiveness of his teaching. He may be interested to know how effective the methods of teaching and/or the instructional aids used have been.

He can ascertain this by giving a quiz; or a test, oral questions, or even assignment etc. The results obtained from such exercise will enable him to know the level of understanding his learners have attained as a result of the teaching. It will also help him to detect areas of misunderstanding or weaknesses in his learners over such lesson or topic. For example, suppose the teacher has just concluded a lesson on measures of central tendencies in statistics; but upon administering a quiz on the lesson the

teacher discovers that most learners cannot differentiate between median, mode and mean, he may see the need to either re-teach the lesson or give some remedial measures. The quiz given to the learners was an evaluative instrument and has enabled him to have a feedback that a remedial lesson will be necessary. At the same time the individual learners would be able to assess himself/herself on how well he has understood. The evaluation measure will enable him to see the need to sit up and work harder if he did not do well enough.

3.2.2 Feedback to the School and Administration

Evaluation will help a school as a system to rate its mathematical stand among other schools. For example, if the results of West African Examination Council (WAEC) show that all or almost all the students of a particular school attain a credit level in mathematics yearly, this will give the school a high rating in mathematical performance in the neighborhood. Its mathematics teachers will be rated good and it can lead to the school capturing more students in that neighborhood because they want to pass the subject at WAEC level.

As an administrative system, a school through evaluation of mathematical instruction will be able to give progress result of a student to his/her parents. It will help her counselors on how to guide the learners on their future careers, she will be able to take decisions on new learners or prospective ones e.g. for selection or fresh admission into the school, etc.

3.2.3 Feedback to Parents / Guardians

Evaluation of mathematical instruction will enable parents/guardians to have feedback of how their child or ward performs in that subject. This will in turn enable them to know what encouragement to give to their ward, whether he needs special home coaching or such. They will be able to guide him on his future career, etc. If they feel the school does not have effective teachers in mathematics, they can decide to change the school of their ward, etc.

Hence, in various ways; evaluation of mathematical instruction gives feedback to all stakeholders in mathematical learning and teaching.

SELF ASSESSMENT EXERCISE 1

Highlight and discuss the purpose of Evaluation.

3.3 Types of Evaluation

Majorly two types of instructional evaluation are used in schools, which include (i) formative evaluation and (ii) summative evaluation.

Formative evaluation is the on-going type. It is the type given when the instruction is on-going; i.e. it is given at intervals of the on-going course, or the currently taught course. It gives a progressive feedback of the course or the unit, which in-turn may reinforce or motivate learning. It also serves the purpose of diagnosing errors in learning, areas not well understood by learner's e.t.c. The teacher is then able to adjust his teaching, examine his methods and plan remedial teaching where necessary.

Summative evaluation is used to determine the end-of-course, end of semester/term or end of session/year achievement. The result is used to assign grades or to determine whether the objectives identified at the beginning of the programme or courses have been achieved or not.

There are other types of evaluation that are not frequently used in the classroom instructional situation, these include:

(i) Diagnostic Evaluation

This type of test is used to locate areas not well understood by learners in the course of teaching, such that when detected, suitable remedial teaching can be planned and given by the teacher. Although not frequently used, every mathematics teacher should endeavor to plan and administer this type of testing both to help his learners and to improve his teaching.

(ii) Prognostic or aptitude test

These types of test is designed such that the future performance of an individual can be predicted on the basis or correlation observed between two or more skills.

SELF ASSESSMENT EXERCISE 2

Highlight and explain the different types of Evaluation

3.4 Techniques of Evaluation of Mathematics Instruction

The techniques of obtaining information on mathematical attainment of a learner are many and varied. For assessing mathematical behavior at the intellectual level, cognitive level, the following techniques can be used.

(i) Written Test

A test is a tool or measuring instrument for evaluation. It is an examination of mathematical knowledge of the learner; it can be inform of questions to answer or activities to carryout. The response of the learner will be assigned a numerical score based on his performance in the test. The numerical score assigned becomes an indicator of how well he possesses the characteristics or quality being measured.

Broadly speaking, there are two types of tests which are the essay and the objective tests; these will be given detailed treatment in the next unit.

(ii) Assignment

This is an allocation of a piece of work given to the learner to do within a specified period of time. The learner is expected to do the pieces of work using the experiences to which he has been exposed by the teacher. Such work is usually individual based and may require efforts and use of initiative of the learner. It may be paper and pencil work, may involve drawing sketches and diagrams, construction of models, use of library, etc. On completion, such assignment will be graded and is useful in obtaining information on the mathematical achievement of the learner in the examined area.

(iii) Oral Questions

Another technique of evaluation is in the use of oral questions. Under this technique the mathematics teacher through questioning tries to determine how much his learners have learnt, or to recapitulate or consolidate what has been learnt; to detect areas not well understood by students in what he has taught, etc.

Through learners responses, the teacher is able to evaluate the extent of their understanding of the mathematical concepts taught, or if any aspect is not well understood. In a similar fashion through the questions asked by learners, he is able to determine whether they understand or not where learners fail to ask questions at the end of a lesson, it shows they have not understood the lesson.

(iv) Learners Self-Evaluation

This technique gives each learner the opportunity to evaluate himself by stating how well he has understood the lesson or the course. It is assumed that every learner can evaluate himself to some extent.

Therefore, after the mathematics teacher finishes teaching a unit or a topic in mathematics; learners may be giving the opportunity to evaluate himself.

The following may serve as a sample guide.

(v) Sample

Mathematics Self Evaluation Form

Topic: (e.g.) Areas of Polygons

Name: ..... Class.....

Date.....

Tick any of the following to rate your understanding of the above unit:-

I. The unit is

Very well understood

Well understood

Fairly understood

Not understood

Not at all understood

II. In the unit indicated above

(i) Which area do you understand most?

(ii) Which area do you least understand?

(iii) Which area do you need help?

While the first part gives a general assessment, the second part makes the learner to be more specific. Their responses can also be used to diagnose areas of problems. For example, if most learners indicate same problem area as where they need help, the teacher may deduce that such area will need re-teaching.

ANSWER TO SELF ASSESSMENT EXERCISES

SELF ASSESSMENT EXERCISE 1

The purposes of Evaluation includes:-

(i) Evaluation provides feedback to the teacher and the learners
(ii) Evaluation enhance feedback to the school and administration
(iii) Evaluation gives feedback to Parents and Guardians

(i) Provision of Feedback to the teachers and learners

Every teacher needs to know how effective his teaching has been. Evaluative measure helps him to know whether he has done well or need to sit up and put in more effort in his teaching. This can be done by

giving a quiz or unannounced test assignment etc. The result can be used to know the level of understanding of his learners. He may then need to re-teach the lesson or give some remedial measures.

(ii) Feedback to the School and Administration

In the same vein, evaluation will help a school as a system to rate its mathematical stand among other schools. For instance, a good performance of students in the General Certificate Examination (GCE) will definitely place such particular school at a high stand and rating. Also, the administrative board of a school through evaluation would be able to give progress report.

(iii) Feedback to Parents/Guardian

Evaluation of mathematical instructions will enable parents to have feedback on the performance of their wards. This will consequently help them to know the areas or the subjects in which their children requires motivation, encouragement and other special coaching in order to effect improvement.

SELF ASSESSMENT EXERCISE 2

Types of Evaluation highlighted and explained

(i) Summative Evaluation

Summative evaluation is used to determine the end-of-course of a semester or a term, end of a session/year achievement. The result of this is used to assign grades and determine whether the objectives identified at the beginning have been achieved.

(ii) Formative Evaluation

Formative evaluation is the on-going type, which is the type given when the instruction is on-going; that is, when it is given at the intervals of the on-going course, or the currently taught course. It also serves the purpose of diagnosing errors in learning that is areas not understood by learner etc.

(iii) Diagnostic Evaluation

This type of test is used to locate areas not well understood by learners in the course of teaching, such that when dictated, suitable remedial teaching can be planned and given by the teacher. Although not

frequently used, every mathematics teacher should plan and administer this type of evaluation.

4.0 CONCLUSION

From the fore-going discussion, you should have observed that evaluation is a important aspect of the school system in general, and of mathematics in particular. In-deed, it should be seen as an essential ingredient in the mathematical instructional programme. It provides feedback to all stakeholders in mathematical learning and teaching. It makes possible to report on the learners' progress and to take relevant decisions where necessary. The next unit discusses in detail the testing process as an instrument of evaluation.

5.0 SUMMARY

In this unit, the following issues has been discussed:-

(i) The meaning of evaluation has been given
(ii) The purposes of evaluation have been stated
(iii) The various types of evaluation discussed
(iv) The techniques of evaluation have been fully analysed
(v) The difference between various types of evaluation has been discussed.

6.0 TUTOR MARKED ASSIGNMENT

What do you understand by Evaluation?
List and discuss four techniques that may be used in the mathematics classroom.

7.0 REFERENCES/FURTHER READINGS

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UNIT 3 EVALUATION OF INSTRUCTION IN MATHEMATICAL TEACHING AND LEARNING II

CONTENTS

1.0 INTRODUCTION

The last unit took you through the general aspects of evaluation which includes meaning of evaluation, purpose of evaluation, types of evaluation and techniques of evaluation. This unit will expose you to the more specific types of evaluation. Specifically, tests measurement and testing procedures shall be examined.

Tests are instruments for carrying out evaluation, it is therefore important in the over-all objective of evaluation. This unit therefore exposes you to detail treatment on testing.

2.0 OBJECTIVES

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

(i) Explain the relationship between test and measurement
(ii) Give definition of a test.
(iii) Outline the purpose of test
(iv) State classification of test
(v) List the criteria for a good test
(vi) Relate a general guide for writing objective tests item

3.0 MAIN CONTENT

3.1 Relationship between Evaluation, Tests and Measurement

The three concepts above are related especially when discussing evaluation of learners' achievement. It is therefore necessary to explain the relationship among the terms.

As highlighted earlier, evaluation is the systematic process of determining the extent to which instructional objectives are achieved by learners. A test is one of the instruments used in the process of evaluating. When a test is conducted, the data obtained from the results of test or any such evaluating activities is called measurement. The judgment or assessment made on the measurements is the evaluation. For example if Gabriel scores 28% in mathematics, on the basis of his score, we judge, or conclude or assess him to be poor in mathematics. If John's height is measured to be 1.9 meters, we conclude or judge on the basis of his measured height that he is a tall fellow. In the above examples the activities that produce the data e.g. the score in mathematics is the 'test'; the data obtained e.g. score of 28% or height of 1.9 metres are 'measurements' while the judgement or conclusion arrived based on the data obtained is the evaluation.

Test then is a major tool or instrument used for evaluation.

Obviously, you will agree that a meaningful evaluation is possible only if the instrument used to provide the data is effective. It is therefore important to select or develop an instrument appropriate for the purpose for which it is to be used. Hence this unit is given to detailed discussion on tests and the process of testing, since this is a major instrument/tool in the process of evaluation in the mathematics classroom.

3.2 Definition of Test

A test refers to a set of questions or items designed and to be responded to by one or a group of individuals within a specified period of time. Tests are used mainly as measures of achievement, to show how much

an individual has learnt or not learnt in an aspect of instruction to which he has been exposed. It is therefore a major instrument in the process of evaluation.

3.3 Purposes of Tests

Among other things, tests serve the following purposes:

(i) Provides feedback to teachers and learners

Test provides the means whereby a teacher can determine whether a unit, a course of instruction he has taught, say in mathematics has been successful or not. For example if the learners perform reasonably well, it means his teaching has been successful and he can go on, if otherwise, he may need to decide whether to reteach the lesson or provide other ways of remediation. It also helps him detect the particular areas where learners have difficulties.

Tests also help to inform learners on whether he is making progress in his studies or not. If he finds that he is not doing well the result of the test may jolt him to work harder. At the same time, he will be able to detect the areas where he is not doing well, and will lead him to pay particular attention to it.

(ii) Motivates learners and teachers to hard work.

Tests provide incentives that make both learners and teachers to work harder. For example, whenever learners are informed that a test will be given, they prepare for it by studying more which usually results into more learning. Hence learners are motivated to study more regularly and seriously when they are aware of an impending test than when there is no indication of a test. It has been observed that when a learner has many courses he is offering and limited time available for each of the course; the courses or subjects in which less tests or examination are given receive less attention from the learner than those in which frequent tests are given. For the teachers too when they are made to give frequent test they sit up more to work because they have to set the tests which must be in line with the instructional objectives they also need to mark and grade the tests. Sometimes too, extra lessons are held to look at the tests with the class for the purpose of corrections. All these means that teachers are kept busy in a system where regular tests are given. The foregoing show that tests induce both teachers and learners to work harder.

(iii) Tests provide means of measuring Teachers effectiveness

Tests, particular final examinations are also used to measure the competence and efficiency of teachers whose students are examined in such finals especially external examination. For example, in external examination such as West African Examination Council (WAEC), schools whose students perform very well in mathematics attract the public attention favorably. Such successes are usually attributed to the competence and effectiveness of their teachers. On the other hand schools whose students perform poorly are looked upon derrogatively and their teachers are considered both incompetent and ineffective. Hence tests/examinations serve as means of measuring teacher's efficiency, especially in these days when the public uses results of examination results to measure how good a school is.

SELF ASSESSMENT EXERCISE 1

List and discuss four purposes of tests.

3.4 Criteria of a Good Test

There are a number of criteria that should be met when designing a test. They include the following

(1) Validity

This means that the test should measure what it is intended to measure. For example, if a test is meant to measure mathematical achievement of learners let it measure achievement. If it is a diagnostic test, then it should be able to reveal weaknesses in mathematics that should be put right. A single test cannot fulfill all purposes; one should ensure that the right type of test is used for the right purpose.

(2) Reliability

This means that results obtained in the tests should be consistent all other things being equal; i.e. a candidate should score approximately the same mark if he took the test repeatedly assuming that he does not gain new knowledge from his previous attempt of the test. While this ideal is not obtainable, efforts can be made to curb the factors that spoil the perfect testing situation. Such factors that can reduce reliability include

(i) Mental and physical condition of the learner e.g. lack of sleep may affect a learner's mental effectiveness.

(ii) the condition under which the test is given, e.g. a test written in an area where civil fight breaks out and people are under tension will negatively affect performance of candidates

(iii) Inconsistency in the standard of marking adopted by different examiners (say in a large scale examination) or by the same examiner on different occasions

(3) Fairness

The test should be fair even from the point of view of the candidates or outsiders e.g. questions should not be set outside the syllabus, time allotted for the work should not be too much or too little etc.

(4) Discrimination

A test should discriminate between the abilities of candidates. A test in which every candidate score the same mark has not discriminated between abilities and would not serve any useful purpose. At the same time, too wide a spread in marks can be misleading.

(5) Comprehensiveness

A test should cover every aspect of the contents being examined; for example an end-of-course test should cover every area of the objectives highlighted at the beginning of the course.

(6) Ease of Administration and Scoring

The test or examination should be easy to administer and score. This is particularly important when the number of candidates is very large. It may not be a problem when candidates are few.

SELF ASSESSMENT EXERCISE 2

List and discuss the criteria of a good test.

3.5 Classification of Tests

Broadly speaking, there are two types of tests namely the essay type and the objective type. Each of this will be examined below;

Essay Type Tests

The essay type tests examine the learners'

(i) Understanding of the subjects
(ii) Ability to organise his thoughts and demonstrate logical argument
(iii) Ability to think critically
(iv) Ability to apply knowledge to the solution of problems.

In essay type tests, the learner is required to provide fully written answer in response to questions. Examples are the traditional end-of-course or end-of- session tests/examinations..

Advantages and Limitations o Essay Tests

Essay tests have both advantages and limitations. Its advantages include the following:

(i) Questions are easy to compose.
(ii) They test learners' ability to recall information rather than merely recognise factual information.
(iii) They appraise higher-level intellectual abilities like ability to reason and think in abstraction etc.
(iv) They test learners' ability to apply knowledge to solution of problems.

Its limitations include the following among others.

(i) Inability to sample representatively
(ii) The scoring can be subjective and
(iii) Scoring takes much time.

However, the limitations can be controlled by appropriate measures e.g.

(i) Combining the use of essay and objective Tests for better sampling
(ii) Preparing detailed marking scheme which should strictly be adhered to.
(iii) Using essay test for only problems that cannot be easily adapted to objective type. For example, in mathematics, some areas of the subject matter that are better examined by essay type questions include:

(I) Geometrical constructions
(II) Solving word or verbal problems and
(III) Proving Theorems.

3.5.1 Objective Type Tests

These are type of tests in which questions (usually many) have been prepared with a set of possible solution, and the examinee is required to select the correct one.

Types of Objective Tests

Objective tests can be classified as follows:

(i) The completion (or short answer) items.

Here, a question is followed by a blank space in which the examinee is to supply correct answer that will meaningfully complete the idea or sentence.

E.g. the sum of interior angles of a triangle is ……..

A 120^o
B 160^o
C 108^o
D 180^o

(ii) True/False or alternate choice items.

In this type, the question is in form of a statement of facts or explanation and the examinee is expected to confirm by selecting either true or false; right or wrong or Yes or No.

e.g. The area of a circle is given by the formula $2\pi r^2$
True or False

(iii) The Multiple Choice items

In this type, a question or an incomplete sentence is given – usually called a stem. Then a set of suggested answers (known as options or alternatives) are given in which only one of them is correct, the others are distractors or distracters.

The examinee is expected to pick the correct answer either by ticking or circling or as may be contained in the instructions. Example:-
In the following circle the alphabet beside the correct answer.
If a fair die is tossed once; what is the probability of obtaining a 2?

A 1/2
B 1/3
C 1/4
D 1/6
E 2/3

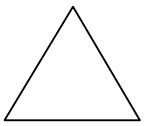
(iv) The Matching items

In this type of test a number of items and a number of responses are listed in different orders. The examinee is expected to match the items correctly.

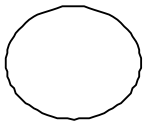
Example:

The following are sets of few geometrical shapes and formulae for finding their areas. Write the correct area formula of a particular shape by its side

A…….  ⌀r2

B…….  **b x h**

C……..  **½ b x h**

D……  **L x b**

(v) The Rank Order items

In this type, a number of items which normally fall into a certain specific order are given in a disarranged order. The examinee is expected to rearrange them in a particular given order.

Example

The following numbers are to be arranged from the least to the greatest.
- 15, -11, -17, -12, +1, -1

Circle the alphabet beside correct arrangement in the following

A	-17,	-15,	-12,	-11,	-1,	+1
B	-15,	-12,	-17,	-11,	-1,	+1
C	-15,	-17,	-11,	-12,	+1,	-1
D	-1,	-11,	-12,	-15,	-17,	+1
E	+1,	-1,	-11,	-12,	-15,	-17

Advantages and Limitations of Objective Tests

The advantages include the following

(i) It can be made much more reliable in their scoring.
(ii) It is easy to score, and less time-consuming non-experts or even machine can mark it.
(iii) It can sample large area of the content of the subject matter.

The Limitations

The limitations of Objective Tests include the following:

(i) Setting objective test questions takes much time, and requires great skill; it is not easy to set.
(ii) It uses much paper, so the cost of printing and duplicating can be much
(iii) Guessing correct answers is possible, so it may not adequately sample the true knowledge of the examinee.

3.6 A General Guide for Writing Objective Test Items

In writing any of test/examination it is important that the examiner decide the behavioral objectives to be tested. This should have been stated at the beginning of the course.
However, specifically for the objective type questions, the following should be noted.

(i) Select the most appropriate item type for the questions
(ii) Present the items clearly and unambiguously
(iii) Avoid giving clues to the key i.e. the correct answer
(iv) Keep the item as short as possible.

ANSWER TO SELF ASSESSMENT EXERCISE

SELF ASSESSMENT EXERCISE 1

Four purposes of tests are listed below:-

(i) It provides feedback to teachers and learners

(ii) It motivates learners to hard work
(iii) It motivates teachers to hard work
(iv) It provides means of measuring teachers' effectiveness.

These above purposes of test are discussed below:-

(i) Provides feedback to teachers and learners

Test serves as a means whereby a teacher can determine whether a unit, or a course of instruction he has taught, say mathematics has been successful or not.

(ii) Motivates learners to hard work.

Test also provides motivation or incentives that make the learners to work harder, for example whenever learners are informed that a test will be given, it usually results into more learning, hence learners are motivated to learn more.

(iii) Motivates teachers to hard work

Test provides incentives and motivation for the teachers, when they are made to give frequent test; they sit up more to work because they have to set the tests which must be in line with the instructional objectives. This enables the teacher to work harder.

(iv) Tests provide means of measuring teachers' effectiveness.

Tests like final examinations are also used to measure the effectiveness or competence of the teachers whose students are examined in such final examination. A typical example is West African Examination Council (WAEC).

SELF ASSESSMENT EXERCISE

Six criteria of a good test include the following:-

(i) Validity
(ii) Reliability
(iii) Fairness
(iv) Discrimination
(v) Comprehensiveness
(vi) Ease of Administration and Scoring

The above listed points are discussed below:-

(i) Validity

This means that the test should measure what it is intended to measure. For instance, if a test is meant to measure mathematical achievement of learners, it has to measure the achievement accurately.

(ii) Reliability

This says that the result obtained in the total results should be consistent all other things being equal, that is, a candidate should score approximately the same mark/score if he took the test repeatedly.

(iii) Fairness

The test should be fair even from the point of view of the candidates or outsiders, e.g. questions should not be set outside the teaching syllabus, time allotted should be appropriate.

(iv) Discrimination

A test should discriminate between the abilities of candidates. A test in which every candidate score equal marks has not discriminated between abilities.

(v) Comprehensiveness

A test should cover every aspect of the contents being examined; for instance, an end-of-course test should cover entirely every area of the objectives highlighted at the inception of the course.

(vi) Ease of Administration and Scoring

This means that the Examination/Test should be easy to administer and score. This is very important when the number of candidate is very large.

4.0 CONCLUSION

The role of test in evaluation cannot be brushed aside. It is a major instrument for evaluation. From results of testing, data are obtained which are formulated into measurements. The judgment or decisions made from such formulations and other measured observation produce evaluation. Therefore, test and testing processes cannot be by-passed in the process of evaluation. It then makes it imperative for you as a teacher or teacher trainer to be conversant with all forms of test and testing procedures.

5.0 SUMMARY

In this Unit, the following issues have been discussed:-

(i) The relationship between test and measurement
(ii) The purpose of test
(iii) The criteria for a good test
(iv) The meaning of a test
(v) Relating a general guide for writing objective test item

6.0 TUTOR MARKED ASSIGNMENT

(a) What is Essay type test and what does it examine in the learner?
(b) What are the advantages and disadvantages of Essay type test?
(c) How can the disadvantages be curbed?

7.0 REFERENCES/FURTHER READINGS

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