COURSE GUIDE

ODL 732
RESEARCH METHODS IN OPEN AND DISTANCE EDUCATION

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CONTENT **PAGE**

INTRODUCTION

This course ODL 732: RESEARCH METHODS IN OPEN AND DISTANCE EDUCATION is a one semester course. It is a two-credit unit course designed for 700 level Postgraduate Diploma in Distance education programme. In other words, it is meant for PGDDE programme of the National Open University of Nigeria (NOUN). There are no compulsory prerequisites for this course, although before this time it is expected that you have gone through some courses like foundations of education which will introduce you to the peripheral details.

This course guide tells you briefly what the course is all about, the course materials you will need and how you can work your way through these materials. It also gives you hints on your tutor marked assignments (TMA); the details will be given to you at your study centre. There are online tutorial sessions that are linked to the course. You are advised to participate in these online tutorial classes. The time and link will be made available at the centre.

WHAT YOU WILL LEARN FROM THIS COURSE

The overall aim of this course ODL 732: RESEARCH METHODS IN OPEN AND DISTANCE EDUCATION is to introduce you to the basic fundamental elements of basic research in ODL so as to appreciate and place value for educational research. During this course, you will learn about very interesting concepts such as research, educational research, variables, scientific enquiry, theory development, hypotheses, research types, research methods, educational research characteristics, research paradigms, research areas, research proposals, research designs, research populations and samples, validity, reliability, statistics, etc.

These concepts and many more will make you have sufficient knowledge to appreciate the need for educational research and ODL researches, which should provide you with the necessary basis for further study.

COURSE AIMS

The aim of this course is to introduce you to the basic fundamentals of research in Open and Distance Education. This will be achieved by aiming to Introduce you to research methods in education, basic types of educational research, research paradigms in distance education, preparation of research proposal, research designs and instruments, :

research population and sampling techniques, validity and reliability of research instruments, statistics in educational research, research reports writing

COURSE OBJECTIVES

There are overall objectives set out in order to achieve the aims set out for this course. In addition, each unit of this course has some performance objectives. These are included at the beginning of every unit. You may wish to refer to them as you study the unit in order to help you check your progress. You should also look at the unit objectives at the end after completing the unit. This will help you ensure that you have done what you are required to do by the unit. The wider objectives of this course, which if met, should have helped you to achieve the aims of the course as a whole are set out below.

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

- define research and educational research ;
- discuss various concepts of educational research;
- describe various types of variables as applied to research ;
- briefly explain the origin and goals of educational research in Nigeria
- give examples of variables in research;
- assess the sources of knowledge;
- describe the purposes of research
- explain the levels of theorising;
- explain the types and characteristics of educational research;
- discuss the problems of having scientific approaches in educational research
- explain the scope of educational research;
- describe the concept of ‘paradigm’,
- distinguish between the three paradigms of research,
- explain the approaches to distance educational research, and
- list the different areas of the research in distance education
- describe the approaches in ODL research
- prepare research proposal;
- identify and classify research designs into quantitative and qualitative researches
- differentiate between instrument and instrumentation;
- develop an instrument for data collection in educational research
- identify a population and select samples for the study
- determine the reliability and validity of a research instrument

- identify and use appropriate statistics for different data analysis
- formulate and test good hypotheses
- conduct a study and write the research report.

WORKING THROUGH THE COURSE

To complete this course, you are expected to read the study units, and other relevant books and materials provided by the National Open University of Nigeria.

Each unit contains self assessment exercises and at certain points in the course, you are required to submit assignments for assessment purpose. At the end of the course, there is a final examination. This course is expected to last for a period of one semester. Below, you will find listed, all the components of the course, what you have to do, and how you should allocate your time to each unit in order that you may complete the course successfully and on time.

ASSIGNMENT FILE

There are assignments in this course, covering all the units studied. You are expected to complete these assignments on your own to help you study and understand. Further information on assignments will be found in this Course Guide in the section on assessment.

THE COURSE MATERIALS

National Open University of Nigeria will provide you with the Course Guide. Also at the end of each unit are lists of books-References and for Further Reading. While you may not procure or read all of them; they are essential supplements to the course materials. Remember also that you must submit answers to the TMAs as and at when due.

STUDY UNITS

The course consists of units. These are made up of the concept of research methods in education, types of educational research, research paradigms in ODL, research proposals, research designs and instruments, population and sampling techniques in research, validity and reliability of research instruments, statistical methods in educational research, formulating and testing hypotheses and writing research reports This material has been developed to suit students in Nigeria and outside Nigeria.

ASSESSMENTS

There are three aspects of the assessments. First are self-assessment exercises, second is the tutor – marked assignments and the third is the final examination. You are advised to be sincere in attending to the exercises. You are expected to apply knowledge, information and skills that you have acquired during the course. The assignment must be done using the computer for formal assessments in accordance with the deadline stated in your schedule of academic calender.

TUTOR-MARKED ASSIGNMNT

There are Tutor-Marked Assignments in this course, and you are advised to attempt all. Aside from your course material provided, you are advised to read and research widely using other references which will give you a broader viewpoint and may provide a deeper understanding of the subject.

Ensure all completed assignments are submitted on schedule before set deadlines. If for any reasons, you cannot complete your work on time, contact your tutor before the assignment is due to discuss the possibility of an extension. Except in exceptional circumstances, extensions may not be granted after the due date.

FINAL EXAMINATION

The final examination for this course will be of three hours duration and have a value of 70% of the total course grade. All areas of the course will be assessed and the examination will consist of questions which reflect the type of self-testing, practice exercise and tutor marked assignments you have previously encountered. Utilise the time between the conclusion of the last study unit and sitting the examination to revise the entire course. You may find it useful to

review your self assessment exercises, tutor marked assignments and comments on them before the examination.

COURSE MARKING SCHEME

The TMA you submit will count for 30% of your total course mark. At the end of the course however, you will b e required to sit for a final examination, which will also count for 70% of your total marks.

HOW TO GET THE MOST FROM THIS COURSE

In distance learning, the study materials are specially developed and designed to replace the lecturer. Hence, you can work through these materials at your pace, and at a time and place that suits you best. Visualise it as reading the lecture instead of listening to a lecturer.

Each of the study unit follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next is a set of learning objectives. These objectives let you know what you should be able to do by the time you have completed the unit. Use these objectives to guide your study.

On finishing a unit, go back and check whether you have achieved the objectives. If made a habit, this will further enhance your chances of completing the course successfully. The following is a practical strategy for working through the course:

- Read this course guide thoroughly.
- Organise a study schedule, which you must adhere to religiously. The major reason students fail is that they get behind in their course work. If you encounter difficulties with your schedule, please let your tutor know promptly.
- Turn to each unit and read the introduction and the objectives for the unit.
- Work through the unit. The content of the unit itself has been arranged to provide a sequence for you to follow.

Also, take note of the following:

Review the objectives of each study unit to confirm that you have achieved them. If you feel unsure about any of the objectives, review the study material or consult

with your tutor. When you are confident that you have achieved a unit's objectives, you can then start on the next unit. Proceed unit by unit through the course and try to pace your study so that you keep yourself on schedule.

After submitting an assignment to your tutor for grading, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments.

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

FACILLITATOR/TUTOR AND TUTORIALS

There will be specific time made available for ONLINE tutorial sessions, in support of this course. You will be notified of the dates, link and time of these tutorials, together with the name and phone number of your tutor, as soon as you are allocated a tutorial group.

Do not hesitate to contact your tutor by telephone, e-mail or your discussion group (board) if you need help.

The following might be circumstances in which you would find help necessary. Contact your tutor if:

-you do not understand any part of the study unit or the assigned readings.

-you have difficulty with the self -assessment exercises.

-you have a question or problem with an assignment, with your tutor's comments on an assignment or with the grading of an assignment. You should try your best to participate in the online tutorials. This is the only chance to have face-to-face contact with your tutor and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain the maximum benefit from course tutorials, prepare a question list before attending them. You will learn a lot from participating in discussions actively.

SUMMARY

This course is designed to give to you some research skills that would help you improve your research techniques and thus conduct research project in partial fulfillment for the requirement to have this diploma in distance education. We, therefore, sincerely wish you the best and that you enjoy the course.

MAIN COURSE

CONTENT **PAGE**

MODULE 1 INTRODUCTION TO RESEARCH

UNIT 1 RESEARCH METHODS IN EDUCATION

CONTENTS

1.0 INTRODUCTION

Research is a vital tool in the educational enterprise. It is a systematic study of a problem with a view to advancing the frontiers of human knowledge. The purpose of research is to identify, explain, discover, control, and predict human behavior on certain issues and problems. There will be no need for research, if there are no problems. The purpose of research, therefore, is to provide solutions to problems. In this unit you will learn about research and educational research.

2.0 OBJECTIVES

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

- define educational research
- briefly explain the origin and goals of educational research in Nigeria
- discuss various concepts of educational research
- describe various types of variables as applied to research.

3.0 MAIN CONTENT

3.1 Meaning of Research

Research may be defined as the systematic and objective analysis and reporting of controlled observations with a view to arrive at the development of generalisations, principles, theories or explanation of phenomena. Generally, research aims at discovering, correcting, and interpretation of new facts. It is also concerned with modifying, revising, or verifying accepted theories or conclusions based on new information. You can also conceive research as a combination of experience and reasoning. On the other hand, research is commonly defined as the systematic, objective, and accurate search for the solution to a well-defined problem. To uphold these comments, either in data collection, analysis or in data reporting, statistics becomes a veritable tool. You should therefore, bear in mind as educational researchers that in expressing or disseminating research information, the language you employ should be clear, definitive, and concise. When you make inferences under uncertainty, the degree of certainty is specifiable. This is one of the objectives in research in education.

In recent time, you cannot easily lay your hands on any reputable journal, either in counseling, psychology, technology, evaluation, administration, tests and measurements, or any other discipline in education, without being confronted with the use of statistics. Therefore, any person or group striving to engage in research of any serious nature should be acquainted with some essentials of statistics. To mention a few, such statistical essentials include some elements of sampling techniques, sampling distributions, descriptive statistics, and some methods of analysing differences in evaluation, spread, and proportion. The use of statistical tables may be veritable. The methodology of research in the behavioural sciences utilises statistics of various types which we shall discuss later in this module.

In Nigeria, research activities in education are predominant in the universities, colleges of education, and a few corporate organisations. Such organisations include the West African Examination Council (WAEC), National Examinations Council (NECO), and the Nigeria Education Research Development Council (NERDC). The NERDC is involved in the formulation of policies in Nigeria, in collaboration with such other bodies as the Federal Ministry of Education and other related supranational educational research bodies. It was established as a distinct educational research institution with its own council in 1970, and as an autonomous government institution with effect from 1971. Apart from conducting researches, it organises or sponsors both national

and international conferences and workshops. It also publishes research reports and provides consultancy services.

The arm of WAEC that is relevant to educational research is the Test Development and Research Organisation (TEDRO). It conducts research and feasibility studies into various activities of the Council, including the study and evaluation of examination papers, standard fixing, testing procedures, and related problems in educational measurement. Some other 'organisation' who rely heavily on educational research are the United Nations Educational Scientific and Cultural Organisation (UNESCO) through the Network of Educational Innovation for Development in Africa (NEIDA), and the African Bureau of Educational Sciences (BASE). The BASE is a pan-African organization established in 1973 following the sixth congress of the International Association for the Advancement of Educational Research. It was set up to assist members states to intensify and harmonise their research activities in the fields of education. You will also note the efforts of the federal government to promote research through the Tertiary Education Trust Fund (TETFund). The National Open University of Nigeria has also queued into this effort by making available some amount of money for research purposes. You can take advantage of these provisions to get on with your research after finishing this course.

SELF-ASSESSMENT EXERCISE

i. Trace the historical development of educational research in Nigeria.
ii. Give three reasons why research is relevant in education.

3.2 Concepts of Educational Research

The term "concept" has similar meaning to "Construct". A concept is an abstraction from observed events; it is usually a word that represents the similarities or common aspects of subjects or events that are otherwise different from one another, examples are chair, cat, dog, tree, sheep, gas, solid, liquid, etc. These words describe common aspects of things that are otherwise diverse. The purpose of a concept is to simplify thinking by including a number of events under one general heading. Some concepts of events are close to the events they represent. For instance, the concept of **tree** may be easily illustrated by pointing to specific trees around us. Also the meaning of the concept **dog** is grasped because we can point to dogs around us. The concept is an abstraction of the characteristics of dogs that are more or less "heavy" or "light". "Mass", "energy", and "force" are concepts used by physical scientists. They are of course more abstract than concepts such as "weight", "height", and "length". A concept is of more interest to readers of this unit.

"Achievement" is an abstraction formed from the observation of certain behaviours in children. These behaviours are associated with the mastery of "learning" of school task like reading ability, formation of words, solving mathematical problems, drawing pictures, and so on. The various observed behaviours are put together and expressed in a word like "achievement" and "intelligence". "Aggressiveness", "conformity", and "honesty" are all concepts used to express varieties of human behavior of interest to behavioural scientists.

A construct is a concept that has the added meaning of having been deliberately and consciously invented or adopted for a special purpose. "Intelligent" is a concept, an abstraction from the observation of presumably intelligent and non-intelligent behaviours. But as a scientific construct, "intelligence" means both more or less than it may be as a concept. It means that scientists consciously and systematically use it in two ways: First, it enters into theoretical schemes and is related in various ways to other constructs. We may say, for example, that school achievement is in part a function of intelligence and motivation. Secondly, "intelligence" is so defined and specified that it can be observed and measured. We can make observations of the intelligence of the children by administering ***X***-intelligence text to them, or we can ask teachers to tell us the relative degree of intelligence of their pupil/students, (Kerlinger, 1973).

i. **A Concept:** is an expression of an abstraction formed from generalisation of particulars for example, weight. This expression is from observations of certain behaviours or weights.
ii. **A Construct:** is a concept that has been formulated so that it can be used in science. It is used in theoretical schemes. It is defined so that it can be observed and measured.
iii. **A Variable:** is defined as a property that can take on different values. It is a symbol to which values are assigned.

Constructs and Words can be defined by:

i. Other words or concepts; and
ii. Description of an implicit or explicit action of behavior.

A Constitutive Definition

It is where constructs are defined by other constructs.

A Constitutive Definition

It is where meanings are assigned by specifying the activities or operations necessary to measure and evaluate the construct. Operational

definitions can give only limited meaning of constructs. They cannot completely describe a construct or variable. There are two types of operational definitions:

i. Measured – tells us how the variable or construct will be scaled.
ii. Experimental – lays out the details of how the variable (construct) is manipulated by the experimenter.

3.3 Variables

Each element/person/thing from which data are collected is called an observation (in our research work these are usually people/subjects). Observations (participants) possess different types of characteristics. If a characteristic of an observation (participant) is the same for every member of the group, in other words, it does not vary, it is called a constant. If a characteristic of an observation (participant) differs for group members it is called a variable. In research we do not get excited about constants (since everyone is the same on that characteristic); we are more interested in variables.

3.3.1 Meaning of Variables

A variable is any entity that can take on different values. It means that anything that can vary can be considered as a variable. Take weight as an example, it can be considered a variable because it can take different values for different people or for the same person at different times. Similarly, town can be considered a variable because a person's town can be assigned a value.

A variable can be regarded as a concept or an abstract idea which can be described in measurable terms. In research, this term includes the measurable characteristics, qualities, traits, or attributes of a particular individual, object, event, situation or phenomenon being studied.
Variables are properties or characteristics of some event, object, situation, phenomenon or person that can take on different values or amounts. Variables are things that we measure, control, or manipulate in research. They differ in many respects, most notably in the role they play in our research and in the type of measures that can be applied to them.

A concept which can take on different quantitative values is called a variable. As such the concepts like time, age, area, length, speed, weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attributes(s). For instance,

volume is a continuous variable, but gender is an example of discrete variable. Now let us look at the types of variables.

3.3.2 Types of Variables

There are different classifications of variables. These are based on the roles that they play in a research study. The ones described below are not exhaustive but they are the most useful for communication in educational research.

3.3.2.1 Independent Variables

Independent variables are variables which are manipulated or controlled or changed. Let us look at this example- "a study of the effect of motivation on teachers' job performance", the effect of motivation, is used by the researcher to try to determine whether there is a cause-and-effect relationship between motivation of the teacher and his job performance. Therefore, motivation is varied to see whether it produces different job performance from the teachers. We call this a manipulated independent variable (treatment variable). The type and quantity of motivation is manipulated by the researcher. The researcher may decide to analyse the performance based on gender separately to see if the results are the same for both male and female teachers. In this case gender is a classifying or attributes independent variable. The researcher cannot manipulate gender, but can classify the teachers according to gender.

3.3.2.2 Dependent Variables

Dependent variables are the outcome variables and are the variables for which we calculate statistics. The variable which changes on account of the manipulation of the independent variable is known as dependent variable. Let us go back to the example above, a study of the effect of motivation of teachers on their job performance; the dependent variable is job performance. In this case we may decide to compare the job performances of the teachers when they are highly motivated, moderately motivated, lowly motivated and no motivation at all.

The concepts dependent and independent variables apply mostly to experimental research where some variables are manipulated, and in this sense they are "independent" from the initial reaction patterns, features, intentions, etc. of the subjects. Some other variables are expected to be "dependent" on the manipulation or experimental conditions, they depend on "what the subject will do" in response. On the other hand, these terms can also be used in studies where we do not literally manipulate independent variables, but only assign subjects to

"experimental groups" based on some pre-existing properties of the subjects. . Independent variables are those that are manipulated while dependent variables are only measured or registered.

Consider other examples of independent and dependent variables:
Example 1: A comparative study of the leadership styles of secondary school teachers by gender.

Independent variable: Gender of the teacher – male, female.
Dependent variable: Score on leadership styles inventory.

3.3.2.3 Extraneous Variable

These are Independent variables that are not related to the purpose of the study, but may affect the dependent variable. Let us use this example. You want to test the hypothesis that there is no significant relationship between students' gains in Mathematics achievement and their time management. You can see that time management is an independent variable and mathematics achievement is a dependent variable. Other variables like Intelligence, peer interaction, teachers' attitude etc., may as well affect the mathematics achievement, but since they are not related to the purpose of the study, they are called extraneous variables.

Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables; e.g. *Effectiveness of different methods of teaching basic science in the junior secondary schools*. In this case, variables such as teacher's competence, Teacher's enthusiasm, teachers experience instructional materials age, socio economic status also contribute substantially to the teaching learning process. They cannot be controlled by the researcher. The conclusions lack incredibility because of extraneous variables.

3.3.2.4 Intervening Variables

These are the variables which intervene between cause and effect. They are difficult to observe, but can be deduced from the individuals feelings such as boredom, fatigue excitement etc. Most of the times times some of these variables cannot be controlled or measured but have an important effect on the findings of the study because they intervene between cause and effect. Though difficult, they have to be controlled using appropriate design. For instance, the topic - *"Effect of reinforcement on learning outcomes"*. Apart from reinforcement there are other factors that can intervene. Some of these variables include

anxiety, fatigue, and motivation. They are the intervening variables. They are difficult to define in operational, observable terms but they must not be ignored and must be controlled by the use of appropriate research design.

3.3. 2.5 Moderator

A moderator variable is an independent variable that is not of primary interest to the researcher. It has levels, and when combined with the levels of the independent variable of interest produces different effects.

SELF-ASSESSMENT EXERCISE

1. Identify and discuss different types of variables.
2. Distinguish between concept and construct.

4.0 CONCLUSION

You have seen the difference between research and educational research. You have also noticed that the federal government is putting research as priority by making available money for that purpose. This is why you need to take this course serious in other to be able to solve your problems through research findings.

5.0 SUMMARY

This unit defined research as a vital tool to achieve the systematic and objective analysis and reporting of controlled observations with a view to arriving at development of generalisations, principles, theories, or the explanation of phenomena. It also explained the origin of research in Nigeria. Different concepts of educational research and types of variables applied to educational research were also discussed. Common variables in research are independent, dependent, active, attribute, and continuous variables.

In the next Unit, we shall briefly look into possible sources of knowledge for the practitioners of education to arrive at more dependable and tested answers. That is precisely what educational research purports to do. In this Unit, we discussed the fundamentals of educational research, namely, its purpose, nature and scope. While we shall also refer to the broad field of education, our focus will be on open and distance education – a subject of your present concern.

6.0 TUTOR-MARKED ASSIGNMENT

1. How can you differentiate between research and educational research?

2. describe the variables in research.

3. Trace the history of research in Nigeria.

7.0 REFERENCES/FURTHER READING

Kerlinger. F.W. (1973). *Foundations of Behavioural Research***.** (2nd ed.). New York: Holt Rinehart and Winston Inc.

UNIT 2 SOURCES OF KNOWLEDGE AND PURPOSES OF RESEARCH

CONTENT

1.0 INTRODUCTION

In the last unit, you studied the concepts of research and educational research. This is the beginning. In this unit, you will learn the sources of knowledge and some of the reasons why you need to study research in education and in ODL.

2.0 OBJECTIVES

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

- describe the sources of knowledge
- explain the purposes of research
- discuss the levels of theorising.

3.0 MAIN CONTENT

3.1 Sources of Knowledge

Human beings have always sought answers to their questions through various methods: experience, customs and tradition, deductive and inductive reasoning, and scientific approach. Information for making educational decisions has come from many sources which include personal *experience,* expert opinion, tradition, intuition, common sense and belief about what is right and what is wrong. Each of these sources may be inadequate if we take it as the only basis for making decisions. Although experience is a familiar and well-used source of knowledge, it would have its limitations as a source of truth.

Customs and traditions have been a traditional source of knowledge; this is equally true in education where educators rely on past practices as a dependable guide. But one has to be careful that notions of past are not blindly idealised. It is wise to value customs and traditions, but be open to examine their relevance in the present context. For example, the customary or traditional notion of education is that of a face to face interaction; does it imply that open and distance education is not feasible?

Both *deductive and inductive reasoning* have made significant contribution towards developing a systematic approach to establish truth. In fact, integration of important aspects of both, deductive and inductive methods, let to the evolution of the scientific approach, which is what we are mostly concerned with in research.

Deductive reasoning is a thinking process in which one proceeds from general to specific statements, through logical arguments. Inductive reasoning derives its argument and strength from the observed phenomena. As both, deductive and inductive reasoning have their limitations, it was only a matter of time that scholars integrated the most important aspects of both methods to evolve a scientific approach.

Scientific approach is generally described as a process in which investigators move inductively from their observations to hypothesis and then deductively from the hypothesis to the logical implications of the hypothesis. They deduce the consequences that would follow if a hypothesised relationship is true. If these deduced implications are compatible with the organised body of accepted knowledge, they are then further tested with the help of empirical data. On the basis of the evidence, the hypotheses are accepted or rejected.

This approach, or ‘research’ as source of information, has been increasingly used to prepare strategies and arrive at definite conclusions. As research systematically describes or measures reality in an objective way, it is a better source of knowledge, than one’s own experience, customs and traditions, deductive or inductive reasoning.

3.2 Purpose of Research

It is clearly evident from our discussion in the previous pages that a researcher deals with a wide range of associations, from concrete day-to-day activities and problems to a philosophical level of search for truth. The purpose of research can be captured in a hierarchical/taxonomic fashion.

- The lowest level or the first level in the purpose of research is training.
- The second level is research for problem solving, and
- The third and the highest form is research in search of truth or knowledge generation.

Training in Research

Research in education, as much as in distance education, is largely of two types:

- One leading to postgraduate degrees like, M. Phil or Ph. D.
- The other dealing with project research.

Training takes different shapes depending on whether the project is a post-doctoral activity or pre-doctoral activity by persons who have not been trained in research methodology. Many of you who undertake programmes like Master of Arts in Distance Education (MADE) or Post Graduate Diploma in Distance Education (PGDDE), may have been working in schools, colleges, universities or even outside these systems and have not done a doctoral programme involving a course on research methodology. Even those of you who have doctoral degrees in language, linguistics or science, may not have a course on research methodology. However, executing a research project in a scientific manner needs training in research methods. This course on research methodology provides the theoretical background for your research project. This print material is supplemented by interactive contact programmes, primarily to strengthen the conceptual aspect of research methodology. This will also facilitate the right choice of research designs, tools and techniques. Hence, training in research methodology is an important purpose of research in distance education, particularly this programme.

Those who have had the opportunity of undergoing a professional course on research methodology followed by some project, would already be well aware of this course and may not need any formal input but can still refine their skills.

Problem Solving

The second purpose of research is diagnosing and solving the problems in the system. In this case, the system is distance education. While we talk of problem solving, it is necessary to develop a more comprehensive view of it. For instance, it may also mean a realistic understanding of a situation on the basis of data and statistics. Let us take the case of the personal contact programmes - a universally

practiced method of student support services in distance education. A project that undertakes to study the difference in the performance of those who attend the personal contact programmes and those who do not, provides a sound empirical basis of assessing the role of Personal Contact Programmes.

Similarly, most of the countries, including Nigeria, invest considerable amount of money on educational mass media, television in particular. The studies that assess the extent of media utilisation and also show the differential performance of those learners who use media and those who do not, provide a revised understanding of the role of media in distance education. Such examples can be multiplied but may not be necessary. In other words, a series of studies will go into diagnosis and develop better understanding of the practices in a system. This may also include study of socio-economic background of students.

Another set of studies may actually get into experimenting with an innovative solution. For example, a distance education institute can model its contact programmes into a two-week or three-week module, tutorial or lecture modes, group interactive mode or group assignment mode and so on. At the end of such exercises, the institute may assess the differential performance of the distance learners exposed to differential treatment. This will provide the distance learning institution an empirical basis for designing the contact programmes. Similarly, there are several alternative formats in the medium of television, e.g. lecture, interview, documentation, drama and docu-drama. The programmes can be developed in different formats and their impact on distance learners assessed.

There can be experiments in the administrative area as well. For example, most distance education institutes send printed instructional material by post, a common practice all over the world. Some of the universities in the western world offer it on line so that a distance learner can either read it from the monitor or download the text at his/her work station. The National Open University of Nigeria delivers printed instructional material to the study centres by trucks. Students are advised to come and collect the material from the study centres. The analysis of this practice has shown that it causes minimum loss of material and is also quite cost-effective.

Examples of research for problem solving can be multiplied. The important point is to recognise that research can contribute to solving day-to-day problems. All the research projects in distance education can actually take the shape of problem solving. It I important to recognise that there is no clash of interests between purposes of research for training and problem solving. Both can go hand-in-hand. This is

particularly true for project research in MADE where most of the participants are not trained in research methodology but many of them are well experienced in distance education and are very familiar with the problems in the system.

Search for Truth: Scientific Inquiry and Theory Development

Search for truth is the biggest challenge in research. Research in search of truth is often classified as pure research in the otherwise controversial pure-applied research continuum. The search for truth, from the angle of research, is the ability to generalise and thus, create knowledge. Such generalizations are derived from occurrences in repeated instances. You would have come across words like significant at .05 or .01 levels. These typical research statements basically promise that such and such instances will happen in 95% or 99% of the cases; and to that extent the phenomenon is generalisable. Generalisations are drawn primarily on two basis, namely, repeated observation in various possible situations and application of statistical designs where the variables are statistically controlled. Generalisations are drawn through tests of significance, levels of confidence, and such other types of analyses.

Project research which is the prime focus of this course is unlikely to achieve this sophisticated level of search for truth. However, it is quite possible for you to undertake a study that could come close to generalisation through application of statistical models and methodologies. Such research, however, will be based purely on quantitative techniques. There are qualitative methods of research as well. Such methods can also be applied in search of truth. Important emphasis, however, is on the use of scientific approach to research.

The scientific methods can be explained in a series of steps, the exact formulation of which varies from one author. The steps are as follows:

- certain phenomenon are observed,
- a problem situation which develops therein, is noted and clarified,
- crude relationships are tentatively identified and elaborated,
- a more or less formal hypothesis is derived,
- a design is developed to test the hypothesis,
- the hypothesis is verified or refuted, and
- the results are subjected to further tests and refinements.

Finally, the conclusions of research are integrated with the existing knowledge of the subject. The process involves such subsidiary steps as:

- review of relevant experience,
- manipulation of factors,
- measurement of the quantities,
- defining of variables, and
- analysis and interpretation of data.

Facts and Theories

Scientific enquiry starts with fact and then moves towards theorising. To be useful, facts must be organised, and the primary purpose of the scientific method is to develop a mechanism of organising the facts, as they accumulate, and become meaningful from stand point of their objectives. Through empirical investigations, scientists gather many facts. As these facts accumulate, there is a need for integration, organisation and classification in order to make the isolated findings meaningful.

Science must remain close to facts. It is only when isolated facts are put in a perspective by integrating them into a conceptual scheme promoting greater understanding that we approach the domain of science. When isolated facts are integrated into a conceptual scheme which promotes a better understanding of their nature and significance, it is clear that the facts have been already put in proper scientific perspective. Significant relationship in the data must be identified and explained. In other words, theories must be formulated. Theory may be defined as "a set of interrelated constructs (concepts), definitions and propositions that present a systematic view of a phenomena by specifying relations among variables, with the purpose of predicting and explaining the phenomena" (Kerlinger, 1973).

Theory knits together the results of observations, enabling scientists to make general statements about variables and relationships among variables. For example, in Boyle's Law, a familiar generalisation summarises the observed effects of change(s) in temperature on the volumes of all gases by the statement – "When pressure is held constant, as the temperature of a gas increases, its volume is increased and as the temperature of a gas is decreased its volume is decreased." This statement of theory not only summarises previous information, but predicts other phenomena by telling us what to expect of any gas under any change(s) in temperature.

Just as fact underlies theory, theories underlie facts – each raising the other like a spiral to an increasingly precise scientific formulation. Each derives their significance from theoretical framework into which they bring facts into focus. This is well stated by Van Dalen (1973):

……..…there is a constant and intricate relationship between facts and theory. Facts without theory or theory without facts lack significance. Facts take their significance from the theories which define, classify and predict them. Theories possess significance when they are built upon, classified, and tested by facts. Thus, the growth of science is dependent upon the accumulation of facts and the formulation of new or broader theories.

This is particularly true in the early stages of scientific development, since in its early stage, research must confine its efforts to seeking answers to highly specific and particularised problems. In the later stage, it tends to strive towards unity by breaking down the very barriers that had made its earlier progress possible. Scientific theories attempt to organise the tiny rigorous defined bits of knowledge into a more meaningful and realistic structure. This is precisely the function of theory.

Hypothesis and Theory

A hypothesis, when accepted, explains a small number of facts and the relationship between them. Generalisation, as the term denotes, is a hypothesis based on broader phenomena. Theory, explains even more facts and their inter-relations. Theories themselves range from the simple to the more sophisticated. Finally there are laws, which have the greatest scope and generality.

In spite of the strong case that has been made for the role of theory in research, it will be appreciated that a theory has to be amended or abandoned when the discovery of a new facts can no longer accommodate it. Alternatively, it may be subsumed by a wider, more embracing theory when it is realised that the situation which is contained by the theory is one instance of a more general case. Theories generated by the means that we have indicated, do not led to “eternal truth; rather, they should be looked upon as useful conceptual frameworks which are adequate for present purpose or a given situation. Thus, every theory is subject to modification as and when we get new facts and evidence that contradict the generalisations made earlier on.

Purpose of Theory

There are several purposes to be served by a theory in the development of science. We shall briefly consider three of them here. First, theory summarises and puts in order the existing knowledge in particular area. It permits deeper understanding of data and translates empirical findings into a more easily retainable and adaptable form. The theory of

oxidation for instance, places into focus many of the chemical reactions common to everyday life.

Secondly, theory provides a provisional explanation for observed events and relationships. It identifies the variables that are related and the nature of their relationship. A theory of learning, for example, could explain the relationship between the speed and efficiency of learning and such other variables as motivation, reward and practice.

Lastly, theory permits the prediction of the occurrence of phenomena and enables the investigator to postulate and, eventually, to discover hitherto unknown phenomena. At the time when the "Periodic Table" was being completed, for instance, certain gaps were noted in the sequence of the elements. Since theory provided that, there should have been no gaps, scientists were spurred on to look for the other missing elements. In time, these were found, anticipated by theory. Theory, therefore, stimulates the development of new knowledge by providing the lead for further inquiry.

It is important to stress that good theories are not born out of imagination; they do not originate merely through arm chair reflection. A theory is built upon collected facts. The investigator then searches, makes intelligent guesses as to how the facts are ordered, adds missing ideas or links, and puts forward a hypothesis; deduces what consequence should follow from the hypothesis and looks for further facts which are consistent or otherwise with the deductions; builds a wider generalisation or conceptual framework on more facts; and eventually outlines a theory. Therefore are solidly based on evidence. And they are important practical tools which enable us to advance our knowledge still further. Once a theoretical framework has been elaborated we know what facts to look for to confirm or to deny the theory; also, we have a conceptual framework inside with which our evidence can be tested.

Theories always involve terms that refer to matters that cannot be directly observed. For example, gravity itself cannot be directly observed, though the effects of gravity can be. Gravity and gravitation are both theoretical terms. The terms of a theory or theoretical statements are sometimes referred to as constructs. Thus, many theories of learning refer to a motivational factor in behavior. Now motivation is not directly observable. It is a theoretical term; or we may refer to it as a construct. The term implies that it is a construction of the scientist's imagination.

3.3 Levels of Theorising

A product of all research in behavioural sciences is a set of conclusions that involves theoretical terms. These conclusions may be at a sophisticated level of theorising or at a level of theorising that is quite low. Most psychologists would agree that it is wise to keep theorising down to the level that involves a minimal use of abstract terms. We may think of six levels of theorising, which we briefly discuss below.

Level 1. Hypothesis formation: This is the level of hypothesis formation. Any hypothesis which is to be used as a basis for research goes beyond the facts on which it is based. The purpose is to establish the existing state of affairs. Nearly all surveys are conducted for this purpose. Thus, students of education may conduct a survey of what the pupils think of a particular aspect of the curriculum; how much time is spent by pupils in watching television, etc. Direct study of aspects is probably the simplest to undertake though this does not mean that it is easy to plan and execute.

Level 2. Elementism: Examples of theories at this level are primitive forms of classification in terms of some significant set of ideas or idea. In the case of education and distance education, classification of abilities derived from factor analysis, or the classification of teaching acts that may be the result of extensive classroom observation, would come under the level of elementism.

Level 3. Descriptive theories and taxonomies: Formulation of descriptive theories and taxonomies occurs at a more complex level than mere classification. An example of theorising at this level is the taxonomy of human learning provided by Gagne. Gagne classified learning into eight different categories, which vary from the most simple to the most complex. Bloom's taxonomy of cognitive behaviours can also be placed under this level.

Level4. Classification: For development of any kind of useful classification system, there is a need for a set of theoretical ideas to underlie the classification. The classification of animals acquired significance only after it was realised that, the species could be fitted into a system in which the evolutionary relationships between animals became the basis for classification.

Although the concept of evolution became a basis for systematic classification of living creatures the theory of evolution itself represents theory construction at a higher level. In this type of theorising, abstract ideas are introduced to explain relationships between observed phenomena. The classical conditioning theory of Pavlov falls into this

class of theorising. The dog learns to salivate at the sound of the bell because the sound of the bell and the presence of food are conditions that become linked in some unseen way in the brain of the animal. Theories at this level may still be quite primitive; for example, it is quite difficult to carry out theorising at higher levels in behavioural and social sciences.

Levels 5 and 6. Postulates and theories: the higher levels. These are levels of theorising observed in physical sciences. At the highest level, a theory consists of a set of basic statements called the axioms of theory, which tell us what the theory is all about. Such axiomatic statements or postulates as they are called, include primitive terms. These are terms that are intuitively understood and cannot be otherwise completely defined.

One distinction that can be made between Level 5 and Level 6 is that the former is reserved for incomplete theories. And the latter, i.e. Level 6 theories represent the ultimate in scientific formulations. They represent the closest approximations to what one might call the accurate description of universal laws.

4.0 CONCLUSION

In this unit, you have seen that knowledge can be sourced through various ways. You also read through the purposes of research and the levels of theorising. These are some of the facts which you will need in your research activities.

5.0 SUMMARY

You have learnt the sources of knowledge which include custom and tradition, deductive and inductive reasoning, scientific approaches, technology, among others. You also saw the different purposes of research. You also learnt that one of the products of research is to make conclusions which involve theorising. You read through the levels of theorising. In the next unit you will be learning the types of educational research.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the main sources of knowledge.
2. Describe the purposes of research.
3. Explain the different levels of theorising.

7.0 REFERENCES/FURTHER READING

Kerlinger. F.W. (1973). Foundations of Behavioural Research**.** (2nd ed.). New York: Holt Rinehart and Winston Inc.

UNIT 3 BASIC TYPES OF EDUCATIONAL RESEARCH

CONTENT

1.0 INTRODUCTION

This unit builds on the general background to research discussed in the previous units and examines different types of educational research and their characteristics. By implication, you are to determine when to use each of the different types of research discussed.

2.0 OBJECTIVES

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

- explain the various types of educational research
- highlight the traits of each type of educational research
- discuss various characteristics of educational research.

3.0 MAIN CONTENT

3.1 Types of Educational Research

There are three basic types of research. They are:

i. Historical
ii. Survey
iii. Experimental

Historical Type

This type of research is based on oral evidence; (Mouly, 1978) records such as diaries, past history, autobiography, logbooks, etc. Books, journals, magazines, etc are also useful documents. The purpose of an historical research is to obtain a better understanding of the present,

through the evaluation of the past and intelligent prediction of the future. An historical research aids in avoiding past errors and predicting the future and also refreshes ones memory on what is known and unfolds what is not known. There are two main sources of collecting historical data. They are primary and secondary sources. Primary sources are relics and other things that have direct physical relationships, e.g. observation and participation. A secondary source deals with bibliographies, references, materials, and documents recorded by someone else. These are less reliable than the primary sources. In this type of research approach, statistical hypothesis are rarely used.

Survey type

Survey type of research can also be called a descriptive research; this type of research is based on information gathered through questionnaires, interviews (oral, written, structured, unstructured, etc), inventories, rating scales, self-report, and observations. Descriptive research is used to find the meaning and obtain an understanding of the present conditions. The results obtained through this procedure can be statistically analysed.

Experimental (Empirical) type

This type of research involves conducting experiments for research process. The researcher will find out the effects of manipulating some variables by providing various treatments and later compared with an untreated group called control group. The results obtained through this procedure are usually statistically analysed. Experimental research is a precise research technique designed to solve specific educational problems. It is perhaps the most reliable type of research that determines situations. In conducting experimental research, three types of variables are usually taken into consideration. They are dependent, independent, and intervening variables.

3.1.2 Basic Methods of Research

i. **Descriptive Method**

Describes systematically a situation or an area of interest factually and accurately, e.g. population census studies, public opinion surveys, fact-finding surveys, task analysis studies, questionnaire and interview studies, observation studies, job descriptions, etc.

ii. **Case and Field Method**

Studying intensively the current background status, and environmental interaction of a given social unit; an individual group, institution, or community, for example, the case study of a child whose IQ is above average, but who is having severe learning disabilities.

iii. **The Experimental Method**

This method Investigates possible cause-and-effect relationships by exposing one or more experimental groups to one or more control groups not receiving the treatment.

iv. **Quasi-Experimental Method**

This approximates the conditions of the true experiment in a setting which does not allow the control and/or manipulation of all relevant variables. The researcher must clearly understand what compromises exist in the internal and external validity of its design and proceed within these limitations. Most so-called field experiments, operational research and even the more sophisticated forms of action research attempt to get at the causal factors in real life setting of the effectiveness of any method or treatment condition where random assignment of subjects to methods or conditions is not possible.

v. **Survey Research Method**

In a survey research method, you study large and small populations (or universes) by selecting and studying samples chosen from the populations to discover the relative incidence, distribution, and interrelation of sociological and psychological variables. Surveys covered by this definition are often called sample surveys. Probably because survey research developed as separate research activity, along with the development and improvement of sampling procedures, Survey research is considered to be a branch of social scientific research, which immediately distinguishes survey research from the status survey.

vi. **Casual-Comparative (Ex-Post Factor) Method**

Investigating the extent and possible cause-and-effect relationships by observing some existing consequence and searching back through the data for plausible causal factors, for example, you may want to identify factors related to the “drop-out” problem in a particular school, using data from records over the period of say twenty years; or to identify possible causes of students poor performance in external/public

examinations, (e.g. WAEC, NECO, SSCE, etc.) in general or in any particular subject of interest.

vii. **Applied Research**

Applied research deals essentially with conducting research in an attempt to provide solutions. Under applied research, we have Action Research, Investigative Research, and Evaluation Research.

viii. **Action Research**

Action research is different from other types of research because of its usefulness. This type of research is used by classroom teachers, office administrators, and policy makers. The research attempts to develop new skills, new methods, and approaches and tries to solve problems with direct application to the classroom situation, (Adewumi, 1988).

SELF-ASSESSMENT EXERCISE

i. List and describe the different types of educational research.

ii. Students are not performing well in English and Mathematics because teachers are using outdated techniques and students are not actively involved. Which research type can you use to improve achievement?

   a. In the long-term?
   b. In the short-term?

3.2 Characteristics of Educational Research

As a science, educational research possesses the following characteristics:

i. **It is Empirical**

It involves the collection of data that can be used to draw conclusions. Conclusions are not based on what the author feels or think but on concrete evidence derived from the data collected by careful observation of the events being investigated.

ii. **It is Theoretical**

Education research, as a scientific research, also aims at the building of a relevant theory that can explain certain phenomena among variables in educational situations.

iii. **It is Cumulative**

Each scientific investigation tries to build upon existing facts and theories and helps in refining and extending the existing principles.

iv. **It is Non-Ethical**

It does not consider issues. That is, scientific investigations do not seek answers to questions such as whether an action is right, or wrong. They attempt to find the logical explanation for any action and avoid value judgment.

It is Verifiable

A scientific investigation leads to verifiable results. The process adopted in any scientific investigation is such that it can be replicated by other researchers who invariably can get the same results, (Koleoso, 1999), all other things being equal.

SELF-ASSESSMENT EXERCISE

Highlight and discuss various characteristics of educational research.

a. In what ways would the primary education component of the National Policy on Education (1998) have been different if an appropriate research had been conducted?

b. Which type of research would have been carried out?

4.0 CONCLUSION

You have seen the different types of research in education. They are applied in different situations. Every type of research needs different type of approach and methods. It is your duty to apply your knowledge in choosing a research type to suit your research condition.

5.0 SUMMARY

In this unit, you have learnt types of educational research to include historical, survey, and experimental types. You have also been exposed to basic methods of research. These include: descriptive, case and field, experimental, quasi-experimental, survey research, etc. The characteristics of educational research are that it is empirical, theoretical, cumulative, non-ethical, and verifiable.

6.0 TUTOR-MARKED ASSIGNMENT

Discribe three characteristics each of historical, survey, and experimental research.

7.0 REFERENCES/FURTHER READING

Adewumi, J.B. (1988). *Introduction to Educational Research Techniques***.** Ilorin: Gbenle Press Ltd.

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UNIT 4 SCIENTIFIC APPROACH IN EDUCATIONAL RESEARCH

CONTENT

1.0 INTRODUCTION

In the last unit, you learnt the different types and approaches of research. You have also learnt that research is scientific in nature. But this is not as perfect as in the natural sciences. There are some limitations to this. In this unit you will learn about this. Let us go through them.

2.0 OBJECTIVES

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

- explain scientific approach in educational research
- describe the limitations of educational research to scientific approaches
- explain the scope of educational research.

3.0 MAIN CONTENT

3.1 Scientific Approach in Educational Research

Unlike physical and biological sciences, education and social sciences deal with living humans. Hence, the subject of educational research poses much greater complexity than that in natural sciences. The usual criticism is that educational and other social science research largely emanates from ill-conceived notion of research and its application in complex human setting. The educational researcher needs the wisdom to choose research designs and methodologies that are responsive to the problem; this is, in contra-distinction to the obsessive use of complex quantitative methods. The issue is that of a careful balance between quantitative and qualitative techniques of research depending on the

nature of the problem, the nature of data and even the sample drawn for the study.

Although problems of discovery principles of human behavior are difficult, they are not impossible. Social scientists will need to carry out observations as carefully as are done in physical sciences. Subjective, qualitative judgments need to be supplemented by more exact, quantitative measurements which are not easy to achieve in the case of human beings. This lack of 'quantifying' and 'generalising' of data, quite often becomes a drawback in educational research as well. Whereas exact sciences tend to become increasingly quantitative in their units, measures and the terminologies, in social sciences most of the matter is qualitative and does not approve of quantitative statements. We may talk of growing indiscipline, but unless we can measure it, we cannot generalise the concept.

Research in education adopts both quantitative and qualitative techniques. Social sciences have not been able to establish generalisations equivalent to theories of the natural sciences or, to predict events accurately. Perhaps, social sciences will never realise the objective of science as completely as natural sciences do. In fact, there are several limitations involved in the application of the scientific approach in education and the other disciplines of social sciences. Let us try to see what they are:

(i) Complexity of subject matter:

A major obstacle is the inherent complexity of the subject matter. Natural scientists deal with physical and biological phenomena. A limited number of variables that can be measured precisely are involved in the explanation of many of these phenomena, and it is possible to establish universal laws. For example, Boyles' law on the influence of pressure on the volume of gases, which deals with relatively uncomplicated variables, formulates the relationship between phenomena that are apparently unvarying throughout the universe.

On the other hand, social scientists deal with the human subjects. They are concerned with the subject's behavior and development both, as an individual and as a member of a group. There are so many variables acting independently and in interaction, that must be considered in any attempt to understand complex human behaviour. Each individual is unique in the way he or she develops, in the mental equipment, in social and emotional behaviour and in application of the overall personality. The behaviour of humans in groups and the influence of the behaviour of group members on an individual must also be dealt with by social scientists. A group of first-graders in one situation will not behave like

first-graders in another situation. There are learners, teachers, and environments, each with variables that contribute to the behavioural phenomena observed in a setting. Thus, researchers must be extremely cautious about making generalisations, since the data obtained in one group situation may not be valid for another group.

(ii) Difficulties in observation:

Observation, the *sine qua non* of science, is more difficult in the social sciences that in natural sciences. Observation in social sciences is more subjective because it frequently involves interpretation on the part of the observer. For example, the subject matter for investigation is often a person's responses to the behaviour of other. Motives, values and attitudes are not open to inspection. Observers must make subjective interpretations when they decide that behaviours observed indicate the presence of any particular motive, value or attitude. The problem is that social scientists' own values and attitudes may influence both the observations and the assessment of the findings on which they base their conclusions. Natural scientists study phenomena that require little subjective interpretation.

(iii) A chemist can objectively observe the reaction between two chemicals in a test tube. The findings can be reported and the observations can be easily replicated by others. This replication is much more difficult to achieve in social sciences. An American educator cannot reproduce the conditions of a Russian educator's experimental teaching method with the same precision of replication as that with which an American chemist can redo a Russian chemist's experiment. Even within a single school building, one cannot reproduce a given situation in its entirety and with precision. Social phenomena are singular events and cannot be repeated for purposes of observation.

(iv) Interaction between an observer and subjects:

An additional problem is that mere observation of social phenomena may produce changes that might not have occurred otherwise. Researchers may think that X is causing causing Y, when, in fact, it may be their subjective observation that X causes Y. For example, in the well-known Hawthrone experiments, changes in the productivity of workers were found to be due not to the varying working conditions but to the mere fact that the workers knew they had been singled out for investigation. Investigators are human beings, and their presence as observers in a situation may change the behaviour of their human subjects. The use of hidden cameras and tape recorders may help minimize

the interaction in some cases, but much of research in social science includes the responses of human subjects to human observers.

(v) Difficulties in control:

The range of possibilities of controlled experiments on human subjects is much more limited than in natural sciences. The complexities involved in research on human subjects present problems in 'control' that are unparalleled in natural sciences. In the latter, rigid control of experimental conditions is possible in the laboratory. Such control is not possible with human subjects. The social scientist must deal with many variables simultaneously and must work under conditions that are much less precise. They try to identify and control as many of these variables as possible, but the task is very difficult.

(vi) Problems of measurement:

Experimentation must provide for measurement of the factors involved. The tools for measurement in social sciences are much less perfect and precise than the tools of the natural sciences. We have nothing that can compare with the precision of the ruler, the thermometer, or the numerous laboratory instruments. We have already pointed out that an understanding of human behaviour is complicated by the large number of determining variables acting independently and in interaction. The multivariate statistical devices available for analysing data in social sciences take care of relatively few of the factors that are obviously interacting. Furthermore, these devices permit the researcher to attribute the variance only to factors operating at the time of measurement. Factors that have influenced development in the past are not measurable in the present, and yet they significantly influence the course of development.

Since research in behavioural sciences including research in education is complicated by these factors, researchers must exercise caution in making generalisations from their studies. It will often be necessary to conduct several studies in an area before attempting to formulate generalisations. If initial findings are consistently confirmed, then, one would have more confidence in making broad generalisations.

Despite these handicaps, education and social sciences have made great progress, and their scientific status can be expected to

increase as scientific investigation and methodology become more systematic and rigorous in their research activities.

Check Your Progress 4

What are the constraints in applying scientific method to educational research?

Notes: (a) Space is given below for your answer.

(b) Compare your answer with the one given at the end of this Unit

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Fig.4.1

3.2 Scope of Educational Research

Scope of educational research can be viewed from the angles of substantive areas of education and research methodology. The two parameters are interrelated and are represented in the matrix below:

Methodology ⟶ Area of Education ↓	Historical	Descriptive	Experimental
Philosophy of Education			
Teacher Education			
Curriculum			
Other(s)			

Fig.4.2

Let us first look at the scope from the methodological perspective.

Methodological Classification

Earlier, we discussed the two categories in which all research can be fitted in.

This categorisation, that of basic and applied research, is true for educational research as well. In addition, educational research can be categorised differently under four types: Historical research, Descriptive research, Experimental research and Action research. Brief notes on all these types and the methods involved therein are given below to continue the discussion.

Historical research

This type of research describes *what was*. The process involves investigation, recording, analysing and interpreting the events of the past in order to make generalisations; these generalisation are helpful in understanding the past, building a perspective about the present, and to a limited extent, in anticipating the future. The main purpose of historical research, therefore, is to arrive at an exact account of the past so as to gain a clearer perspective for the present. And this knowledge further enables us, at least partially, to predict and control or future existence/activities.

Descriptive research

This type of research describes *what is.* It involves the description, recording, analysis and interpretation of conditions that exist. It involves some type of comparison or contrast and attempts to discover relationships existing between variables. Much educational research is aimed at describing the characteristics of students and the educational environment. The nature of prevailing conditions, educational practices and existing attitudes must be determined before we can move onto solving problems about learners, institutional organisation or the teaching of a subject. Research of this nature may not answer basic questions, but it does permit the gathering of information which serves as a basis for future research.

Experimental research

This type of research describes *what will be* when certain variables are carefully controlled or manipulated. The focus is on the relationship between two sets of variables. One set of variables is deliberately manipulated (experimental treatment of the independent variable) to examine its or impact on another set of variables (dependent variables). For example, in one of the experimental studies, a distance education

tutor held specially designed contact classes (independent variable or treatment) for a particular group of distance learners and studied its impact on their performance in the university examination (dependent variable). The experimental research involved systematic recording of data and scientific analysis later. This type of research leads to developing testable hypotheses, generalisations and predictions. This methodology is derived largely from the physical sciences. We will bring you more details on experimental research later.

Action research

Action research involves the application of the steps of the scientific method to educational problems. Although it is similar in some respects to experimental research, action research differs principally in the extent to which findings can be generalised. Primary concern for action research is problem solving; hence, it is focused on the immediate application and not on the development of a theory. Many action research projects are carried out in a single classroom by a single teacher; and the others, by all the teachers in an institution or even any aspect. Is findings are to be evaluated in terms of local applicability, not in terms of universal validity. Its purpose is to improve institutional practices.

A typical example of action research in distance education institution:
The institution was receiving complaints of not receiving study materials in time. The material was sent by post. It was decided to send the study material to the study centres and the students were advised to collect the study materials from the study centres personally. The data on number of complaints, cost of loss on transit, additional cost at study centres, cost of transport were studied on comparative basis with the practice through postal delivery. The study indicated net reduction in complaints and the matching cost involved.

In this case, the problem of delivery of material was solved through action research. We will bring you more details on action research in later.

Interdisciplinary fields of inquiry

Education is an interdisciplinary field of inquiry that has borrowed concepts and theories from physics, biology, psychology, sociology, anthropology, political science, economics and other disciplines. The methodologies used in educational research are also derived from several disciplines, e.g. systems analysis from biology, experimental designs from physical and natural sciences, observation and

interviewing from anthropological sciences, testing from the discipline of psychology, and the like.

4.0 CONCLUSION

As earlier mentioned, unlike physical and biological sciences, education and social sciences deal with living humans. Hence, the subject of educational research poses much greater complexity than that in natural sciences. The usual criticism is that educational and other social science research largely emanates from ill-conceived notion of research and its application in complex human setting.

The educational researcher needs the wisdom to choose research designs and methodologies that are responsive to the problem; this is, in contra-distinction to the obsessive use of complex quantitative methods. The issue is that of a careful balance between quantitative and qualitative techniques of research depending on the nature of the problem, the nature of data and even the sample drawn for the study. This has been the focus of this unit.

5.0 SUMMARY

In this unit, you have learnt about the following:

- scientific approach in educational research
- limitations of educational research to scientific approaches
- the scope of educational research.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss the limitations of educational research to scientific approaches.

7.0 REFERENCES/FURTHER READING

Adewumi, J.B. (1988). *Introduction to Educational Research Techniques.* Ilorin: Gbenle Press Ltd.

UNIT 5 RESEARCH PARADIGMS IN DISTANCE EDUCATION

CONTENTS

1.0 INTRODUCTION

Distance education has significant components which are more industrial than academic in nature. The development of distance education is being shaped by technological, demographic and political forces, as well as distance teaching experiences of the practitioners. These components bring in *changes* in this system rapidly and radically. In other words, you can say that research is essential to know the effect of changes so that future decisions in the field of distance education can be shaped according to the results of the present study and previous developments. It will provide a basis for decision making and policy formation (Koul 1993).

You are already aware that distance education is not simply a mode to deliver learning materials through different media, but a form of educational experience which requires analysis in terms of the range of strategies, the techniques and tools used to improve its practice. There is always a concern for directing research activities in distance education to the real needs of the participants-those engaged in teaching at a distance, the distance learners, those who provide support services and the administrative and management systems which deliver distance education. As a student of distance education, we hope that this Unit

will familiarise you with the developing traditions of research activities in distance education, to understand why research is directed towards certain problems or phenomena and to design models, patterns or ways in which you can go about conducting research in distance education. We will inform the possibilities, approaches and limitations of various tools and techniques, models etc. This will enable you to analyse, theorise and pose questions which deal with a large number of teaching and learning issues, macro perspective involving social and political effects, impact of distance education system, and communication issues.

This Unit will serve as a guide for the beginners of research in distance education. It is assumed that the field of distance education has produced and will continue to yield growing bodies of knowledge. But, knowledge does not grow naturally or inexorably. It is produced through the critical inquiries of practitioners or scholars – and is, therefore, a function of the kinds of question asked, problems posed and issues framed by those who conduct researches. To understand the methods and findings of research carried out in the field of distance education, one should appreciate and utilise the varieties of ways in which research questions are formulated. The framing of research questions, like that of an advocate asking questions in a court of law, limits the range of permissible responses and prefigures the character of possible outcomes. In other words, it is essential that a researcher understands the questions that have been asked and the manner in which those questions have been framed, both conceptually and methodologically.

As a researcher, you should know why research is formulated in a specific fashion, you should know the alternative approaches to inquiry, how to work on a research project, how to select a tool and how to prepare a design for research. The paradigms of research will provide you a solid background in each of the research discourses and allow you to explore the trends of research from a global perspective. In a way, these paradigms inform us about problems and procedures which are consistent with researching within a specific social, cultural, economic and political framework. Keeping in view the above facts, this Unit provides you a detailed discussion pertaining to paradigms of research.

2.0 OBJECTIVES

By the end of this Unit, you will be able to:

- describe the concept of ‘paradigm’,
- distinguish between the three paradigms of research,
- explain the approaches to distance educational research, and
- state the different areas of the research in distance education.

3.1 Research Paradigms in Distance Education

There are a number of issues pertaining to the nature of research in distance education: for example, whether the proposed research topic is as per the need of the situation; how shall the topic be viewed by the wider community of distance educators engaged in research activities; what sort of theoretical interpretation might lie behind the research questions; what is the status of research in distance education and how to theorise and generate knowledge in distance education. To answer these questions it would be useful to introduce the idea of various model and approaches to research. Many researchers have talked about the way scientist use models known as maps or *paradigms* to develop a *framework* for distance educational research.

The paradigm approach provides for a solid background in each research exercise and helps us to follow up, in depth, specific areas. This background is an essential part of the development of models in distance education research.

There is always a concern for directing research activity in distance education to the real needs of the participants – those engaged in teaching at a distance and those who provide services to deliver distance education. It is also essential to connect research in education and social sciences. For example, there are some commonalities between much of what occurs in distance education and the work done with individualised instruction, independent study, and technology. Coldeway (1990: 388) emphasised that the enormous amount of work done on personalised instruction systems could be used to form base line data to begin research in distance education. The research should deal with *micro perspectives* such as teaching and learning at a distance and macro perspectives involving social and political effects, impact of the distance education system, communication technology, etc., which will form a mine of information. In other words, although distance education is very different from education in a conventional setting, research carried out on conventional campus based students can provide a framework for developing research paradigms for students studying at a distance.

The Concept and Genesis of Research Paradigms

The concept of paradigm has turned out to be useful in inspiring critical thinking about "normal science" and the way shifts in basic scientific thinking occur. A paradigm determines the criteria according to which one selects and defines problems for inquiring and how one approaches them theoretically and methodologically. A paradigm could also be regarded as a cultural artifact, reflecting the dominant notions about

scientific behaviour in a particular scientific community, be it national or international and at a particular point in time. In other words, we can say that paradigms determine scientific approaches and procedures which and out as exemplary to the new generation of scientists – as long as they do not oppose them. A 'revolution' in the world of scientific paradigm occurs when one or several researchers at a given time encounter anomalies; for example, they may conduct experimental studies, make observations, which in a remarkable way do not fit the prevailing paradigm. Such anomalies can give rise to a crisis after which the universe of research under study is perceived in an entirely new light.

Previous theories and facts become subject to thorough rethinking and re-evaluation. It is relatively easy to point our changes in paradigms in natural sciences. For example, in physics paradigm shift occurred from Aristotle via Galileo and Newton to Einstein. But when research activities in social sciences emerged in the nineteenth century, a conflict was observed in the field of research concerning both the purpose and method of inquiry. Alternative perspectives have been proposed and accepted by many. The value of alternative approaches was not denied, since scholarly debates and the exploratory use of these alternative approaches, add vitality to the field. During the 1960s, scholars from different social science disciplines studied educational problems with many disciplinary affiliations. Most of them have a background in psychology or other behavioural sciences, but quite a few of them have humanities background in philosophy and literature. Thus, there cannot be a single paradigm prevailing like in the normal science in the multi-faceted field of research in education. So, the scholars contributed new methods and new perspectives.

Some scholars argue that there are two main paradigms – the (i) scientific and the (ii) humanistic which are not exclusive, but complementary to each other. Nevertheless, it can be argued that the drawing of a distinction between these two approaches cannot be sustained to the extent that they are regarded as two different paradigms. The twentieth century has seen the conflict between these two as employed in researching educational problems. The one which is modeled on the natural sciences shows emphasis on empirical quantifiable observations and analysis data with mathematical tools. The other paradigm is derived from the humanities with an emphasis on holistic and qualitative information for interpreting data.

A review of relevant literature indicates four major paradigms:

(i) empirical – analytic (roughly equivalent to quantitative science)
(ii) interpretive – symbolic (qualitative or hermeneutical inquiry)

(iii) critical (where criteria relating to human betterment are applied in research)
(iv) phenomenography.

Let us now examine each of these in detail.

3.1.1 Empiricist Paradigm

This paradigm emphasises careful can controlled observation as the basis for knowledge. The observer is dispassionate and independent of the object of observation. Knowledge is objective, generalisable and can be used to *predict* and *control* future events (Smith *et.al.* 1990). In other words, within an empiricist research paradigm, the activities or processes proceed in a hypothetical- deductive way. Here we have a theory behind the particular problem we wish to investigate. The theory provides the concepts which pose the research problem. The hypotheses arise from the theoretical framework made up from the concepts and variables interacting with each other. Holmberg (1990: 159) emphasised that scholarly work that tests propositions and modifies theoretical approaches has to be inter subjectively rational, exact, and of non-artisan character.

Since research processes, according to this view, should proceed by the hypothetical – deductive problem method, you need to have some kind of theory for a particular problem you wish to investigate. This theory or model will provide the language and concepts which pose the problem. Your hypotheses will arise from the theoretical framework made up from the way the concepts or variables interact with each other.

For example, you want to *explore the relationship between distance teaching and independent learning.* For this problem the following hypotheses can be formulated with the eventual aim of operationalising the statements and finding ways of empirically testing them. These hypotheses are:

1. Distance learning is possible without a counselor or teacher
2. Emotional involvement in the study promotes deep learning and goal attainment.

You can notice that if we are to move to an empirical approach for testing the above hypotheses, we are **faced** with **a problem** of deciding what we might measure, how to go about measuring emotional involvement, deep learning and goal attainment. So within empiricist research, a hypotheses must focus on a meaningful problem, have clearly defined concepts. After this, to verify our assertion that there exists a relationship between emotional involvement and deep learning,

we have to construct and conduct the test. We also have to design the research activity, whether to select the experimental approach or any other method. If we decide to be experimental in our approach, we have to manipulate the extent of emotional involvement to see whether there is any effect on deep learning. Who will be our subjects? Also, we have to take into account the practical and ethical considerations in attempting this empiricist approach. You can see that you have to prepare a typical pattern for empiricist approach. The steps involved are:

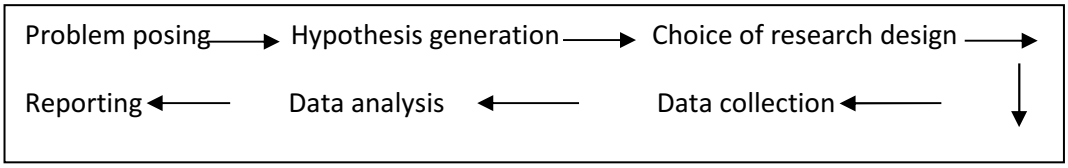

Fig.5.1

Deriving a theory is a deductive principle, but a theory which is based on evidence can be proved only by the induction approach. For example, a researcher observes again and again that friendly communication (feelings of belonging and personal relations between learner and tutors) influences not only motivation but also achievement favorably. General opinion among educators supports the researcher in assuming that what he/she has *induced* from the cases is based on the theory or a law. A theory to this effect is developed and various hypotheses derived from it – and, in fact, agreeing with what has been noticed in practice, and tried empirically. In other words, assumptions are then deduced from theory. In distance educational research we investigate facts concerning the student (numbers, age group, qualifications, socio-economic status, etc.), the use of media and methods, organisation and administration. Accepting this kind of fact finding in research activity implies the assumption that there is, in fact, a reality that can be observed objectively.

SELF-ASSESSMENT EXERCISE

Prepare an outline of a research exercise in an area that you are interested in by using the steps of empirical paradigm.

3.1.2 Interpretive Paradigm – Phenomenology

This paradigm emphasises social interaction as the basis of knowledge. The researchers use their skills as 'social actors' to understand the subjective worlds of others. Here knowledge is subjective, constructed through mutual negotiation and is specific to the situation under investigation. The difference between empiricist and interpretive

paradigms is that the empiricist approach focuses on prediction and control, but the interpretive approach is concerned with the understanding of a particular situation by the researcher.

The interpretive approach focuses on the intentions behind human actions, seeks to uncover, and interpret the meanings of all that is happening, being done or being understood by those who are involved in the activity under investigation (Nunan 1990: 26). This type of research includes *qualitative* methods of study. Here the focus is on the observed present, but the findings are contextualised within a social, cultural and historical framework.

The dominant influence within the interpretive paradigm has been research on students approach to learning. The research study focusing on students' learning, particularly following the phenomenography of Marton and Saljo (1976) explained the deep and the surface approaches. The idea of approaches to learning, though apparently simple, is very useful in understanding why students learn differently under the same circumstances. It is not a learning style inherent in students which they manifest in all situations, but a characteristic of interaction between an individual and learning task. So, it is the interpretation of an intention and an action. It only has meaning with reference to a situation with certain types of content.

From phenomenograph approach, Marton and Saljo (1976) came to this important point about distinguishing deep from surface learning and explained that students would adopt the means of processing academic tasks. If learners merely wished to display symptoms of having learned, they would adopt a surface level approach. If they wanted to grow in understanding, they would adopt a deep level strategy. The approaches to learning movement have influenced distance education literature. From the above discussion you must have realised the impact of interpretive paradigm on deep and surface levels of learning. But what is the **phenomenological** approach? Let us discuss in brief about two **phenomenological** approaches before we proceed to the strength and limitation of interpretive paradigm.

Phenomenology – it is concerned with an interpretive understanding of human action. As a philosophical movement, phenomenology was founded by Edmund Husserl. Its main concern is to provide philosophy with a foundation that will enable it to be a pure and autonomous discipline free from all presuppositions. Its method is essentially descriptive, and its aims are to uncover the fundamental structures of intention, consciousness and the life-world. The idea of the life-world of 'lived-experience' which is always taken for granted even by empirical sciences, is one of the two main concepts of phenomenology,

which has interested many social scientists including psychologists. Nevertheless, critics have argued that when phenomenological concepts are transferred from their original domain to the context of social science, their meaning is radically transformed. In a wider context, we can say that phenomenology has influenced the researchers' analysis of the constructs and the interpretation in reality. For example, an important point about students learning approaches is that one depends upon the student's perception of the course, the teaching and the learning environment.

A range of constructs such as heavy workload, didactic teaching, content oriented assessment and a fact-filled syllabus have been consistently met with a surface approach. The constructs made by the researcher, through phenomenological analysis, in a learning environment help to study the behaviour of the distance learner as the researcher tries to explain in accordance with the constructs whether the learner has deep or surface level learning. The phenomenological analysis of learning approaches has provided the researchers with interpretable tools which are sensitive to the context of the department or the individual learner or teacher; so it helps in designing courses and planning curriculum more conducive to students employing a deep approach.

Phenomenological and interpretive researches derive their responses for the subject and blur the distinction between subjects and objects. Phenomenological concern attends to how subjects make sense of the world. How do learners, or teachers (or whoever) interprets social practice and situations in which they find themselves? Phenomenologists look to the 'object' of study for descriptive first order constructs. What were formerly objects, for example, students, teachers or educational administrators are now subjects.

Phenomenologist adopt an attitude of epochs, where past beliefs, opinions, attitudes, experiences, ideologies, and frames of references propose that the discourse of research emanate from the subjects. Subjects expose first-order constants by which they organize and make sense of their daily lives. Researchers then develop second-order scientific and explanatory constructs that account for first-order constructs.

Some issues such as defining the perceived social situation, collecting data through unstructured and informal approaches should be handled properly to collect relevant information. In any interpretive study, the researcher may sometimes receive information which is not intended for public disclosure. Being a participant and an observer, the researcher carries a number of responsibilities to deal with a particular situation with moral considerations because the construction of meaning from an

observational account and informal interviews is a key activity in interpretive paradigm. The limitation of the interpretive paradigm is that there is no inherent mechanism for moving beyond interpretation. If this paradigm is followed, the researcher depends on the level of interpretation and there is no mechanism for moving on towards remediating the identified problems.

3.1.3 Critical Paradigm

The critical paradigm emphasises that knowledge is problematic and capable of systematic distortion. It represents the interests of some groups within society and has the potential to be either oppressive or emancipating. This approach shares the assumptions of the interpretive approach but adds the above element. One of the concerns of the critical paradigm is to understand the theory as well as practices.

Now, to reconceptualise this research activity, let us take the example of learning styles of a distance learner. In this case, our first concern will be to try and understand the practices of distance learners as they engage in learning. As a participant in this research, the researcher will be setting up strategies which involve learners in critical reflections about their actions as learners at a distance. The researcher has to listen to their language and conceptual understanding of the way in which the learners are emotionally involved in influencing their abilities to learn and attain their goals. The researcher may anticipate the introduction of social and political contexts in this approach.

Sometimes the researcher may change the situation in order to provide a greater degree of control to the learner. For example, warmth in human relations, and rapport with teachers a distance could be collectively redefined in ways which change the practice of those attempting to facilitate learning at a distance. The use of collective redefined actions by previously isolated and independent students to achieve changes in their involvement within the educational enterprise may also be explored. This is because the critical paradigm sees knowledge developing as participants are actively involved in construction and reconstruction of theory and practice. The approaches involved in this paradigm are emancipator *praxis and* critical pragmatism. For example, *emancipator* praxis identifies a ‘guidance’ role for expert researchers in facilitating involvement of participants; *critical ethnography* supports emancipator action; and *critical pragmatism* extends beyond the typical critical approach and helps for post-structural analysis.

In the critical paradigm, the researcher has to identify the social group of the participants/subjects through dialogue and analysis of the intentions of the participants. He/she has to study the historical development of the

social conditions and the current social structure to understand the group. The researcher has to collect data with the help of participant observation and in-depth interview. He/she has to involve himself/herself to visualise the social situation. The key feature of this paradigm is its concern for finding the truth/facts without distortion or bias. It focuses on sociological and political issues as a research problem.

One mode of research associated with the critical paradigm is *action research* which is a form of participatory and collaborative research, aimed at improving educational settings and teaching and learning practices. Action research aims to help practitioners investigate the connections between their own theories of education and their own day-to-day educational practices. It aims to integrate the research act into the educational setting so that research can play a direct and immediate role in the improvement of practice and its aim is to overcome the distance between practitioners to become researchers. Groups of participants maybe tutors/counselors/teachers of distance learners, heads of institutions, parents and other community members – any group with a shared concern.

Check Your Progress 1

Explain the importance of paradigm in distance education research.

Notes: (a) Space is given below for your answers,

(b) Compare the answer with the one given at the end of this unit

……
……

Fig.5.2

phenomena in and aspects of the world around us are experienced, conceptualised, understood, perceived, and apprehended". Phenomenographers call it a 'second order perspective' (Marton 1981).

This point can be explained with the help of an example taken from a piece of phenomenographic research. One of the ways in which children experience numbers is as "fingers-numbers" which is stated by Numan (1987) and quoted by Marton (1997). Children frequently lay the numbers 1 to 10 in their *fingers* present in two hands, calling one of the little fingers '1' (one), the ring finger '2' and so on. Numbers larger than 5 are then understood as 5+ some fingers. In carrying out simple arithmetical tasks, children try to keep the undivided '5' together. Hence, when solving problems like 2 + 7 = 9, they reverse the addends

and transform the problem by 7 + 2 = ?, where is "undivided" 5 + 2 and the problem as a whole becomes (5 + 2) + 2 = ?.

From the above example, you can understand a concept of something or a way of experiencing something. The two expressions are being used interchangeably. It is a way of being aware of a phenomenon. One might be aware of 7, when one perceives it as 5+2, when one looks at one's hand or as 6+1 or 4+3, it might be an immediate experience of the number 7; it might be the result of reflection or some other possibilities. So, here the perceptions differ in a qualitative way.

Phenomenography is a research specialisation. The researches were carried pit at the University of Goteborg, Sweden, in the early 1970s. The point of departure for these studies was one of the simplest observations that can be made about learning, namely, that some people do better at learning than others. These observations led to the first question which was to be investigated empirically, (a) what does it mean to say that some people are better at learning than others? This in turn led to the second question, (b) why are some people better at learning than others?

This phenomenographical study was carried out with individual tasks provided to the learners under comparatively natural conditions and learners were allowed to read the text provided to them. Thus, after completing their reading, the students were interviewed about what they understood the text to have been about. The interview also pertained to their experience of the situation and they were specifically asked how they had gone about learning the text. All the interviews were recorded and subsequently transcribed verbatim. On examining the transcripts of the students' accounts of how they had understood and remembered the text as a whole, it was found that there were different ways of understanding the text; thus, a hierarchically ordered set of categories were devised and termed the "outcome space".

By referring to this outcome space, the categories of description could be compared with one another to judge how appropriate, in relation to specified answering the second question as to why some people are better at learning than others. Further research for answering the second question demonstrated the relationship between approaches to learning i.e. surface and deep on the one hand and the quality of the outcomes on the other. This phenomenographic study developed the notion of two approaches to learning. The idea of approaches to learning is very useful in understanding why students react differently in the same circumstance.

Thus, two key issues regarding phenomenographic study are as follows:

1. Different ways of understanding a specific content which learners developed in a certain situation; sense was made of these in terms of differences in the approaches the learners adopted to the specific learning task, that is, in terms of differences in their ways of experiencing the specific situation.

2. The second issue is that in developing the phenomenographic research, the focus of interest was to shift away from that which emerges in a specific situation and toward the learner's pre-conceived ideas about the phenomena dealt with in the specific situation. For example, the way in which children understand numbers, is of vital importance to the way in which they deal with problems in arithmetic.

The above discussion points out that, phenomenography is the empirical study of the limited number of qualitatively different ways in which various phenomena can be experienced, understood, perceived and conceptualised. This may be considered as a way of finding out how the development of knowledge and skills within the domains can be facilitated.

In this section, we discussed the research paradigm in distance education and phenomenography which has significant contribution to research studies pertaining to students' learning. So, our research can serve various interests: It can seek forms of knowledge, it can be shaped by various media and it can give rise to a form or pattern of paradigm.

Having presented to you the four research paradigms, we shall now examine a few methodological issues and approaches.

3.2 Approaches to Distance Education Research

Earlier n, we saw how a research method is a particular way of studying a problem. With the increasing number of research studies in distance education, much emphasis is laid on methodological issues and *approaches* to research in this field. In this section, we will present to you a few issues and *approaches* of research.

3.2.1 Qualitative and Quantitative Approaches

Qualitative methods help us to examine the nature of human behaviour and experience and social conditions. But quantitative methods focus on

objective and standardised means of inquiry and application of statistical analysis for attainment of objectivity and generalisations.

Quantitative methods permit the researcher to study selected issues, cases or events in depth. Qualitative data are collected through direct observation, participant observation, in-depth interviewing, case studies, recorded documents, open-ended questionnaires and journals. Quantitative methods use standardised measures that fit diverse opinions and experiences into predetermined response categories. This approach measures the reactions of a large number of individuals to a limited set of questions, thus facilitating questionnaires, attitude scales, rating scales and postal surveys.

The qualitative-quantitative debate has persisted in the field of research. It has been more of a philosophical debate than that of research practices. Qualitative methods have been the subject of considerable controversy among social scientists. The philosophical and theoretical perspectives which undergird qualitative methods include phenomenology, naturalistic behaviourism, and psychology. The philosophical roots of qualitative methods emphasise the importance of understanding the meanings of human behaviour and the socio-cultural context of social interaction. This method estimates validity, reliability and objectivity of a social situation and tries to picture the empirical social world as it actually exists to those under investigation, rather than as the researcher imagines it to be.

A large number of works on quantitative methods offers the use of this method in the context of distance education. Various qualitative research methods like ethnography, case study grounded theory (Minnis, 1985, Marland 1989; Coldeway 1990) and the methodology of critical reflection put forward by Evans and Nation (1989) are considered to be more promising in this context. In recent years, the debate has softened. A consensus has gradually emerged that the important challenge is to match appropriate methods to research questions and not to advocate any singly methodological approach for all research situations. Both qualitative and quantitative data can be collected for/under the same study.

3.2.2 Triangulation Approach

As a reaction to the debate between the qualitative and quantitative approaches, significant researches have highlighted many flexible and eclectic approaches. One of the eclectic approaches in distance educational research is *triangulation.* The choice of research methods follows not from research doctrine, but from decisions in each case as to the best available technique. The problem defines the method used not

vice versa. Equally, no method (with its own built-in-limitations) is used exclusively or in isolation; different techniques are combined to throw light on a common problem. Besides viewing the research problem from a number of angles, the 'triangulation' approach facilitates the cross-checking of otherwise 'tentative-findings'.

As you know, qualitative approach puts more emphasis on participant observation, open-ended questionnaires, in-depth interviewing and analysis of document. On the other hand, quantitative approach uses close-ended questionnaires and survey methods for collection of data. As a precaution against subjectivity in both the approaches, the *triangulation* method insists on cross-checking the important findings through the use of different techniques, coding and appropriate checking of open-ended questions, and independent interpretation of data by different members of the research team. While using this approach, theoretical principles and methodological ground rules can be discussed and made explicit, criteria for selecting or rejecting areas of investigation can be spelt out and evidence can be presented in such a manner that others can judge its quality.

This method attempts to eliminate bias or error and as a result increase the probability of a truthful explanation. There are three major goals of triangulation, namely: convergence, inconsistency and contradiction.

Convergence is the first goal of triangulation approach. Here, the result of data collected from different sources, methods and investigations are combined to provide evidence about a single phenomenon.

Inconsistency – This refers to the inconsistency among the data. Often multiple measures produce conflicting evidence that do not confirm a single proposition.

Contradiction – This refers to the data collected from various sources being not only inconsistent, but also contradictory.

In the context of distance education, some of the research problems are complicated, often confounded with a variety of interlocking variable. Sometimes, it may even be difficult to carry out the research. A triangulation method may prove effective in dealing with a variety of variable. For example, a researcher wants to study the development of the distance education system during the nineties. He/she has to consider a variety of interlocking variables pertaining to instruction, management and logistics. The variables associated with the instructional system are learning strategies, instructional materials, feedback and support system, etc. In management system, the components are organisational structures, policies and procedures of an

institution, leadership and use of researchers. Finally, logistics include technical quality, programme delivery and instructional environment.

The term 'component' refers to one of the features or parts of a system. For example, in distance education system the components are learners, instructional materials, support services, etc. Here, the components that directly affect learners are of particular interest for research. It begins with an analytical phase to identify the nature of each component and how they possibly interact. Once the components are identified, it is possible to determine the contribution each component has towards the overall effect.

For example, a distance education programme has the following components:

i) a printed course package,
ii) a set of audio and video-cassettes,
iii) access to counseling sessions, and
iv) a set of policies related to admission and evaluation processes.

The above components work together to produce a particular effect i.e. achievement, rates of course competition, etc. Suppose a researcher wants to determine which of these components are most important in producing a particular effect, say, completing a programme. The first stage in component analysis research would be to analyse each component in the course to determine whether it exists at a level of quality. For example, to determine the instructional components in the printed package, one has to analyse the well-written objectives, clear presentation and self check questions that match the objectives, of the components. It may be useful to begin research work with formative evaluation than to determine the overall effect of a programme. Component analysis approach is a good way to combine the benefits of evaluation with a potential programme of more generalisable research (Coldway 1990: 394).

3.2.3 Model Building

Model building approach provides ways of addressing important research questions that are ignored while designing the framework of research. It serves to integrate various knowledge bases together. Information outside of distance education can also be used to guide decision making. Calvert (1989) proposed a conceptual framework indicating relationships between various input, process and outcome variables. The framework helps to construct a model of a distance educational research programme. Model building for distance educational research is useful to begin with a research problem and to

predict the difficulties in conducting the research and to estimate the reliability and external validity.

Check Your Progress

List the four approaches to distance education research.

Notes: (a) Space is given below for your answer

(b) Compare the answer with the one given at the end of this Unit.

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Fig.5.3

3.3 Research Areas

Considering the extensive practice of distance education and the investigation made of this practice, there is good reason to categorise these research studies. Studies conducted by various distance education practitioners show uneven distribution across the areas of research. The categorisation of research activities into various areas are done by Holmberg (1996), Panda (1992), Dash (1993), Jegede (1993), Sherman and Nedza (1990) and Moore (1995). These studies emphasise that the core areas of research in distance education have an identity, a sense of questioning and the capacity for qualitative analysis with reference to theoretical approaches.

Evans (1990) mentioned that there are more than 600 universities and colleges with higher distance education programmes in China. Most of them have established research institutes of higher distance education. The issues evoking research's interest in China are: reform problems of distance education, problems arising from satellite television and broadcast education, cooperation and union in distance education and studies for foreign distance education Sherman and Nedza (1990) classified the areas of distance education research into categories. They have explained that interest in research in the field of distance education is worldwide. They have suggested a broad range of topics of research conducted in developed and developing countries:

i) Research, Philosophy and Information,
ii) Student Support and Success,
iii) Curriculum Development and Special Courses,

iv) Tutor and Faculty Development and Evaluation,

v) Technology in Distance Education, and

vi) Administration.

Jegede (1993) collected expert opinion about distance education research in developing countries. The four broad categories of areas that had overwhelming support requiring priority research attention are: study skills (81.3%), professional development (77.4%), management and planning (71.9%) and student evaluation (71%).

Holmberg (1996) analysed the character and scope of distance education as a field of scholarly enquiry which adds weight to the view that distance education is a well delineated field of academic inquiry. Further areas of research in distance education as stated by Holmberg are history, target group, student bodies, the administrative practices, student evaluation, etc.

In an analysis of periodical literature published in four referred journal of Open and Distance Education, Mishra (1997) categorized the papers into seven groups: distance Education in Perspective (18%), Students and their learning (21.88%), Learning materials and related issues (9.4%), Technology issues (14.12%), Management issues (9.14%), Distance Education: Theory, research and training (11.63%) and Distance Education in practice (15.78%).

In the above discussion, we have made an attempt to outline the areas of research in distance education identified by various distance education practitioners. These areas of concern are being subjected to investigation by various researchers the worldover.

Check Your Progress 3

What are the four broad areas of research which require priority attention in developing countries?

Note: (a) Space is given below for your answer.

(b) Compare the answer with the ne given at the end of the Unit.

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Fig.5.4

4.0 CONCLUSION

Let us Sum Up

In this Unit, we have discussed the need for research and development. In section 1 of this Unit, we have focused on the three paradigm of research. They are: empiricist, interpretive and critical paradigms. At the end of the Unit we have explained the research areas identified by various practitioners.

5.0 SUMMARY

CHECK YOUR PROGRESS: THE KEY

1. A paradigm determines the criteria according to which we select and define the problem. It also acts as cultural artifact, which reflects the scientific behaviour in any community. In distance education it provides a background in the research exercise and helps to go in depth.

2. a) Qualitative and quantitative approach
   b) Triangulation,
   c) Component analysis, and
   d) Model building

A research paradigm provides a solid background in each of the research of the research discourses and allows us to understand research problems clearly. It helps us to know the procedure and background for conducting research in distance education.

3. The four broad categories which, according to expert views, need priority attention are:

i) Developing study skills
ii) Professional development
iii) Management and Planning
iv) Student evaluation

6.0 TUTOR-MARKED ASSIGNMENT

7.0 REFERENCES/FURTHER READING

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UNIT 6 PREPARATION OF RESEARCH PROPOSAL

CONTENTS

1.0 INTRODUCTION

Every activity needs thorough planning. When you have thought out a research problem, you must plan how the research will be carried out. This plan which is like the building plan or blueprint to a builder is called **Research Proposal**. The proposal provides a basis for the evaluation of the work and demonstrates clearly that the researcher know what he wants to do to arrive at the solution of the problems at hand. It affords him also, a systematic plan or procedure to follow.

There are various formats for the research proposal and it varies from Institution to Institution. In this unit you will see the format which most institutions make use of.

2.0 OBJECTIVES

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

- list the components of a research proposal
- describe the components one by one
- discuss how to write a research proposal.

3.0 MAIN CONTENT

3.1 Components of a Research Proposal

Abstract

On a single, separate page, prepare a summary of the proposal to indicate its objectives and procedures.

Introduction

- Background
- Statement of the problem
- Purpose of the study
- **research questions and hypothesis**
- Significance of the study (Implications and Application)
- Operational definition of terms
- Assumptions of the study
- Limitations of the study
- Delimitations of the study

Review of the Related Literature

- Literature Review
- Conceptual framework
- Theoretical framework
- Review of related researches
- Appraisal/Summary of Literature review.

Research Methodology

- Research Design
- Subjects (Population and sample; sampling Technique)
- Instruments (construction and administration)
- Validity and reliability of Instrument
- **Method of data collection**
- Statistical Procedure / method of data analysis

Budget and Time Schedule

References

Background to the study

After choosing your research area, there is need to give cogent reasons for deciding to work in this area. This area is of extreme importance as it is the pillar upon which you will build subsequent work. You should advance adequate reasons for choosing the topic. If it was borne out of the shortcomings of previous work or to further knowledge in the area, you will need to explain. You will need to think deeply on how your work and the previous ones will throw more light on the problem area or lead to new knowledge.

Background to the study cannot be treated with levity. It should discuss all the variables in the study and shed light on the problems and its nature.

Purpose of the Study

This is just a simple statement of what the concern of your research work is all about. It should be stated in two or three sentences. It should not be a lengthy affair but straight to the point.

Statement of the problem

The statement of the problem is usually a declarative statement which you must make early at the beginning of your research. This section defines your intention and brings your work into focus. It clarifies outlines and limits the problem area. Thus, it must be good, clear, concise and stated early in the proposal.

You should avoid bringing elements of the background to the study into this section or attempt to justify the work by stressing its significance here. A sentence or two should do the job adequately, e.g.-

This study sought to:

> *"determine the extend to which the mother tongue interferes with the learning of English Language in schools"*

Significance of the Study

Researches are not trivial or superficial endeavours. You should be able to justify the importance of your study in terms of its implications or possible applications to the general practice of education. The emphasis in this section is on the benefits of the study to educational theory or practitioners. All the stated hypotheses and research questions should point to this direction. You should therefore ensure that your study can increase knowledge, solve problems and answer some thorny questions

in the field of education. In addition, it should afford other researchers the opportunity to delve further in the particular area.

Operational Definition of Terms

It is not everybody that will come in contact with your work that will be familiar with the areas of study. You should therefore define terms and concepts as you used them in the study.

All un-usual terms must be defined to avoid their being misinterpreted. All variables, terms or methods of obtaining data that are subject to ambiguity must equally be defined. You should try as much as possible to define them in your own words and as you used them in your study.

Assumption

You may assume certain facts in the course of your research. These must be clearly stated. There are certain facts also you may believe but which you cannot verify. There is need to state them as this will strengthen the basis for your investigation.

Limitations

The research or is often confronted with a number of constraints during the course of an investigation. These are often beyond his/her control. They may place restrictions on the conclusions of the work or their applications in other situations. There are myriads of them ranging from Physical, Human, Financial, administrative policies to invalidated data gathering instruments, time and sampling technique. These limitations should be clearly and concisely stated as they affect your study.

Delimitations

Your study must have boundaries in terms of sample, variables, time, subject matter, location and variable matching. Delimitations show the scope of your investigation and the extent to which conclusions can be extended in terms of sample, variable and subject matter. It is important you state the scope of your study very clearly.

II REVIEW OF RELATED LITERATURE

Theoretical Framework

This may as well be a major part of the review of related literature. Its main purpose is to hinge your study to an existing theory in education. Hardly is there any study that is completely new. A background theory

gives basis for your study. There are a number of theories to which you can link your studies i.e. Bruner, Piaget, Gagne, Deurtsch etc.

The theoretical framework sets the theoretical base for the research.

The other parts of the review of Literature often relate the current research to what had gone before it. When the writings of recognised authorities and previous research are summarised and presented, it lays credence to the fact that the researcher knows much about the current research in terms of what is known and unknown about the subject.

Best and Kahn (1980) stated that "citing studies that show substantial agreement and those that seem to present conflicting conclusions helps to sharpen and define understanding of existing knowledge in the problem area, provides a background for the research project, and makes the reader aware of the status of the issue." It is advised that parading a long list of annotated studies relating to the problem is ineffective and inappropriate. Only those studies that are plainly relevant, competently executed and clearly reported should be included.

Best and Kahn (1980) further advised that the researcher should note certain important elements:

1. Reports of studies of closely related problems that have been investigated
2. Design of the study including procedures employed and data-gathering instruments used
3. Populations that were sampled and sampling methods employed
4. Variables that were defined
5. Extraneous variables that could have affected the findings
6. Faults that could have been avoided
7. Recommendations for further research

Thus, the review of literature is a valuable guide to defining the problem, recognising its significance, suggesting promising data-gathering devices, appropriate study design and sources of data.

It is always good to present the review in topical form as the previous studies can be better organised. It is also better to paraphrase cited works rather than assembling paragraphs upon paragraphs of quotations. The last section of the review of related literature should be an appraisal of the reviewed literature. This in essence is a brief summary of the whole literature showing its congruence with the present study. The findings and their implications will be discussed. The gaps presently existing in what had been reviewed about the topic will be pointed out and how this leads to the problems at hand.

RESEARCH QUESTIONS AND/OR HYPOTHESIS

The problem of the research, which had earlier been generally stated, is now made specific through Research Questions or Research Hypothesis. The formulation of hypothesis clarifies further the nature of the problem and the logic underlying the investigation. Hypothesis also gives direction to the data-gathering process.

Research Hypothesis is a tentative answer to the question being investigated. It is an informed or educated guess or lunch that is based upon prior research to be subjected to the process of verification or disconfirmation Hypothesis are often stated in a **"Null form"** since it is the null hypothesis that will be subjected to statistical test. However, at this stage, they could be stated in the research form so that you can give a clearer picture of the intent of your study and to show the anticipated relationships between the variables in your study.

You should try as much as possible to include the operational definition of each element within the hypothesis otherwise you may need to give definitions and stipulations required to do this separately. Of necessity, hypothesis must be formulated before data gathering so that your investigation will not be biased. The characteristics of a good hypothesis are that it should be

- reasonable
- consistent with known facts or theories
- stated in such a way that it can be tested and found to be probably true or probable false
- stated in the simple possible terms

Data Collection

The data must be collected carefully to ensure its quality. Bias and error must be avoided. Again, there is the need to plan before data collection is commenced. How the data will be organised and presented should have been determined.

The use of tables, figures and charts are essential in organising and summarising data.

Data Analysis

The type of design used for the study is a pointed to the statistical techniques that could be used. This also depends on the type of hypothesis and the type of data (normal, ordinal, interval or ratio). The various statistical procedures are not discussed in this text but will be given in another. You should lay your hand on a good book on Educational statistics. However, the table below illustrates the statistics that could be used for various purposes, with different types of data and for specific purpose.

Table 6.1: Descriptive Statistics

PURPOSE OF THE STATISTICS						
		(1)		***(2)***		***(3)***
Location			***Central Tendency***			***Variability***
Type of Scale of Dependent Variable	One Group	More than One group	One Group	More Than One Group	One Group	More than One Group
Interval	Mean	Difference between Means	Standard deviation or Variance	Difference between Standard deviations or Variables	z-score, t-score or other standard scores	Difference between an individual's standard score in more than one distribution
Ordinal	Median	Difference between Medians	Quartile deviation	Difference between quartile deviation	Percentile tank*	Difference between an individual's percentile rank in more than one distributio

						n
Nominal	Mode	Difference between Modes	Range	Difference between ranges	Label or Categorisation	Label of Categorisation

(4)						***(5)***
(6)						
Correlation						***Subsets***
Interaction						
Type of Scale of Dependent Variable	One Group	More than One group	One Group	More Than One Group	One Group	More than One Group
Interval	Pearsons	Difference in Pearsons for same variables in two groups			Difference between observed cell means and expected cell means in factorial ANOVA (observed interaction)	Difference in observed interaction among groups
Ordinal	Spearman rho or Kendall's W*	Difference in Spearman rhos for same variables in two groups				
	Point	Differen		Differe	Differen	Differen

Nominal	besirial correlation*	ce in point biserial correlations for same variables in two groups	Proportion or percentage	nce in proportion or percentage	ces between observed cell frequencies and expected cell frequencies	ces in observed interaction among groups

* This statistic is not described in this text but may be found in any number of statistics texts.

Table 6.2: Inferential Statistics

PURPOSE OF THE STATISTICS						
	(1)		***(2)***			
		(3)				
Location		***Central Tendency***			***Variability***	
Type of Scale of Dependent Variable	One Group	More than One group	One Group	More Than One Group	One Group	More than One Group
Interval	Standard error of the mean	*t*-test or one-way ANOVA		Bartlett's test* or *t*-test for homogeneity of variance; * *F*-max* statistics	Standard error of measurement	Standard error of measurement
Ordinal	Standard error of median*	Median test, sign test,* Kruskal-Wallis one-way ANOVA, * or Friedma				

		n's test*				
Nominal						

(4)			***(5)***	***(6)***		***Correlation***			***Subsets***	***Interaction***
Type of Scale of Dependent Variable	One Group	More than One group	One Group	More Than One Group	One Group	More than One Group				
Interval	*t*-test for Fisher's *z* transformation or F-test for linearity*	*t*-test Fisher's *z* transformation			*F*-test for multifactor ANOVA	*F*-test for multifactor ANOVA				
Ordinal	Test for Spearman's Rho or Kendall's W*									
Nominal	Chi-square or test for significance of point biserial*	Cochran's *Q**	Chi-square or Fisher's exact test*	Chi-square or Fisher's exact test*	Information theory A*	Chi-square test for information theory A*				

*These statistics are not described in this text but may be found in any number of statistics texts or later modules to be developed.

Source: Donald Ary et al (1979) Introduction to research in education.

f. **Expected End-Product**

This should include preliminary reports of findings periodically during the project, and a final report.

Personnel

Provide name, title and a brief statement of the research experience of the principal investigator and of the other key personnel involved if possible.

Facilities

Indicate special facilities and similar advantages including research staff and resources available to the organisation.

Other Information

Indicate other information pertinent to the proposal including the following:

a. extent of agreed cooperation in project by agencies whose support is necessary for the successful accomplishment of objectives, include names and titles of officials of such agencies giving assurance of cooperation. For example, in a training – research project, cooperation of State Ministry of Education may be vital to the success of the Project (Aina, 1994).

b. amount of financial or other support available for this project from other sources.

c. whether this proposal has been or will be submitted to any other agency or organization for financial support.

d. whether this proposal is an extension or an addition to a previous project supported by the Ministry of Labour or other government agency.

e. whether this project or a similar one was previously submitted to the Department of Labour or other government agency.

Appendix

This is the last part of a research project report. Materials which are related to the report and which can be referred to for greater detail but which are unsuitable for inclusion into the main body report; are usually

placed n the appendix. Such materials are the instrument used for data collection, raw data such as a list of school used for the study, letters of introduction, etc. (Koleoso, 1999).

SELF-ASSESSMENT EXERCISE

1. What steps will you take to write a proposal on a research topic of your choice? State these steps.

4.0 CONCLUSION

In this unit, you have seen the components of a research proposal. It is now left for you to make it part of you as you are going to be making use of it even after your progamme here. It is the first thing your project supervisor will ask you to bring when your topic is approved to know if you are sure of what you want to do.

5.0 SUMMARY

In this unit, you were exposed to the components of a research proposal in which you found out that a research proposal has the following components:- abstract, introduction with its sub components, methodology with its sub components, budget, expected/end outcome, time frame and appendices.

6.0 TUTOR-MARKED ASSIGNMENT

Choose a researchable topic in your area of specialisation and develop a research proposal on the topic.

7.0 REFERENCES/FURTHER READING

Evans, T.D. (1990). (Ed) Research in Distance Education, Geelang, Victoria: Institute of Distance Education, Deakin University.

MODULE 2 RESEARCH DESIGNS AND INSTRUMENTS

UNIT 1 HISTORICAL AND DESCRIPTIVE SURVEY RESEARCH

CONTENTS

1.0 INTRODUCTION

This unit is designed to give you insight into research designs which you can use to do research in education. It explains the purpose, basic characteristics, application, limitation and examples of both the historical and descriptive survey research types.

2.0 OBJECTIVES

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

- classify research design into qualitative and quantitative studies
- outline the different types of educational research designs
- state the purpose, characteristics, limitation and examples of both the historical and descriptive research designs.
- discuss how to apply historical and descriptive research designs to solve problems.

3.0 MAIN CONTENT

3.1 Types of Educational Research Design

Educational research can be classified into broad areas namely; qualitative and quantitative picture approach (Croswell, 1994). Quantitative research is an inquiry into a social or human problem, based on testing a theory composed of variables measured with number and analysed with statistical procedures in order to determine whether the predictive generalisation of the theory hold true. While qualitative study as an inquiry process of understanding a social or human problem, based on building a complex, holistic picture formed with words reporting detailed views of informants and conducted in a natural setting (Leady 1995).

The main types of educational research designs are:

1. Historical research design
2. Descriptive research design
3. Causal comparative research design
4. Correlation research design
5. Experimental research design
6. Survey research design
7. Case study/Field research design

3.2 Historical Research Design, Definition and Purpose

This is the process of systematically examining past events to give an account of what has happened in the past. The purpose is systematic attempt to reconstruct the significant events of the past through analysis, synthesis and verification.

3.2.1 The Basic Characteristics of Historical Research

The Basic characteristics of Historical research include

- Dependent on primary and secondary sources of data collection could be both internally and external criticised.
- It is rigorous, systematic and exhaustive.

3.2.2 Application and Examples of Historical Research Design

- A proper grasp of historical research will help in improving upon some educational practices that have historical.
- Historical reports help us in shaping such practices to suit the present and the future.
- They also help us to appreciate the historical context of grea educationist and their theories
- They can also help us to uncover the works of perhaps some ‘’hidden’’ educational giants in our setting.

Examples:

1. Development of secondary education in Nigeria.
2. The impact of the missionaries on the Nigerian educational system before independence.

SELF-ASSESSMENT EXERCISE

1. Name the two broad approaches to research.
2. What type of research method is involved in the contributions of Alvan Ikoku to the development of Nigerian education?

3.2.3 Limitations of Historical Research Design

1. Non-availability or insufficient quantity of primary data.
2. Inconsistency in policy making.
3. Articles of events are particularly subjected to distortions either through Careless reporting or emphasis on the sentimental with a corresponding Disregard for the truth.
4. Manuscripts are frequently subjected to so many editorial changes.

3.3 Descriptive Research Design

These are the studies which aim at collecting data on and describing in a system manner. Such studies include; observation studies, correlation research, developmental designs and surveying research.

3.3.1 Purpose and Basic characteristics of Descriptive research

The purpose is systematic attempt to describe the characteristics of a given population or areas of interest factually.

Basic characteristics of Descriptive research include:

1. Involves large sample to measure meaningful description.
2. Requires empirical evidences through data gathering processes, which may involve hypothesis testing.

3.3.2 Application of Descriptive Research Design

1. Used in describing the incidence and not interested in testing for any hypothesis.
2. Used in collecting data and describing same in a systematic manner.
3. It is interesting in the characteristic features or fact about a given population.
4. It is used to collect relevant information about the status of some aspect of life.
5. Used to describe certain variables in relation to the population.
6. Used in description of event as they are.
7. To make specific prediction.

3.3.3 Limitation and Examples of Descriptive Research Design

Limitations are:

1. No informed consent

2. It cannot identify cause with all variables present because setting is completely natural
3. Usually rely on convenient samples.
4. Mostly qualitative data and verbal description based on visual observation, and so may lack precision, accuracy and not very sensitive.
5. Takes a long time and thereby a lot are thrown away

Examples are:

1. Factors influencing students' poor performances in the physical sciences.
2. Laboratory management and safety in Nigeria post primary institution.

4.0 CONCLUSION

In this unit, you have been exposed to types of educational research design and their classification into qualitative approaches. You have also the purpose characteristics, application, limitation and examples of both the Historical and descriptive research design

5.0 SUMMARY

You have been introduced into educational research designs by discussing its classifications and examples. You have also learnt about Historical and Descriptive research designs with their applications.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is a Historical research design?
2. Explain four applications each for Historical and descriptive research design.

7.0 REFERENCES/FURTHER READING

Creswell, J. W. (1994). *Research Designs: Qualitative and Quantitative* Approaches.Thousand Oaks.

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Otuka, J.O. (2004). *Educational Reseach Method*.

UNIT 2 CAUSAL COMPARATIVE AND COR RELATIONAL STUDIES

CONTENT

1.0 INTRODUCTION

In the previous unit, we discussed the types of educational research design with particular emphasis on historical and descriptive survey research. In this unit emphasis shall shift to other types that have been found very useful in educational research designs. These include causal comparative and correlation studies.

2.0 OBJECTIVES

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

- define and state the purpose of both the causal comparative and correlation studies
- give the characteristics of causal comparative and correlation studies
- explain the limitations and application of both the causal comparative and correlation studies.

3.0 MAIN CONTENT

3.1 Definition and Purpose of Causal Comparative Research Design

Causal comparative research is a research that attempts to determine reasons or cause for the existing condition. That is it attempts to determine the cause or reason for pre-existing differences in groups of individual.

The purpose:

1. Starting with an effect and seeking possible causes.
2. Attempt to identify cause-effect relationship

3.1.1 Basic Characteristic of Causal Comparative Design

1. It typically involves two (or more) groups and one independent variable.
2. It involves comparison.
3. It is inconclusive and lead to management action that is, the findings from one can be used to develop hypothesis for the other.
4. It is concern with learning "why? That is, how one variable affect another.
5. It is also known as Ex-post factor research design.
6. The researcher usually has no control over the variables of interest and therefore cannot manipulate them.
7. It is used in conclusion of a final solution of an experiment or study.

3.1.2 Limitations of Causal Design Comparative Research Design

- Lack of control over independent variables.
- Difficulty in ascertaining that the relevant causal factors are actually included among many factors under study.

- The use of this approach is complicated by the fact that no single factor is the cause of an event, rather a combination and interaction of factors goes together under certain conditions to produce a given event.

- A particular outcome may not only result from a multiplication of factors, but that an event may be by one factor in one instance and by another factor at another instance.

- When a relationship has been discovered between two variables, there is the problem of deciding which is the cause and which is the effect, and the possibility of reverse causation has to be considered.

- Comparative studies in natural situation do not allow random selection of subjects.

- The fact that two variables are related does not establish a cause and effect relationship.

- This approach often bases its conclusion on limited sample or a number of occurrences.

Examples of causal comparative research design

1. The influence of gender on students' performance in school certificate examination in Nigeria.

3.1.3 Application and Importance of Causal Comparative Design

Application:

- Where the variables involved in the study do not lend themselves to experimental manipulation.
- Where direct control cannot be exercised by investigation.

Importance:

- It yields useful information concerning the nature of phenomena, that is, what goes with what, under what conditions, in what sequence or patterns and the like.

3.2 Correlation Studies

A correlation study determines whether or not two variables are correlated. It is a study which shows whether an increase or decrease in one corresponds to an increase or decrease in the other variable. That is, it is a measure of association between two variables and secondly the description of one variable as a function of another variable.

If the two sets of value can be linearly related, the resulting correlation is proportional. The slope of the regression line is indicative of the strength of correlation, and where the correlation is strongly positive or strongly negative the regression line is close to the 45 degree slope, and if there is a very low correlation, then the line will be nearly horizontal. Squaring the correlation coefficient one arrives at the coefficient of determination, which represents the proportion of common variation in the two variables.

3.2.1 Types of Correlation

1. Linear Correlation (Bivariate correlation): This is a type of correlation which expresses how two variables are linearly correlated.
2. Serial Correlation: This is a method chosen in checking the randomness of data obtained by sampling.
3. Multiple Correlation: This is a type of correlation employed when the number of observations is more than two factors. It also measures the magnitude of the relationship between criterion variable and some combination of product variables.

4. Curvilinear Correlation: This method is used in a wide variation of the actual observations about the fitted linear graphs, it may be difficult to detect such non-linearity, yet the location of the fitted line or graph may depend appreciably upon an essentially arbitrary assumption about the nature of the curve.
5. Partial Correlation: It shows the net relationship between each independent, variable and the dependent variable.

3.2.2 Application and Limitation of Correlation Research Design

1. Correlation research helps us to find out whether two or more variables have relationship or not.
2. It helps us to find out if two or more variables are interrelated.
3. It is used to test for a lack of randomness in series of sample values taken overtime.
4. It is used to determine whether there exist cyclical properties in a sequence of observations.
5. It can be used to determine and or handle any number of causal factors.
6. It is preliminary tool of investigation.
7. It is used in solving problems related to time data.
8. It is used to predict value of variables when the values of other variables are known.

9. It helps in drawing conclusion and inferences.

3.2.3 Limitations and Examples

Limitations:

- It does not establish cause and effect relationship between variables.
- It breaks down complex relationship into simple components.

Examples:

1. Relationship between attitudes to science achievement.
2. The relationship of intelligence in school with the grades in Mathematics and grades in English (example of multiple correlation)

4.0 CONCLUSION

In this unit, you have learnt that causal comparative research attempts to determine the cause for pre-existing difference in groups of individual and know when two variables are correlated.

5.0 SUMMARY

In this unit, you have been exposed to the following:

1. Definition and the purpose of causal comparative
2. Characteristics of causal comparative
3. Correlation studies and its characteristics
4. Limitations of causal comparative and correlation studies.
5. Tutor marked assignment
   Discuss the causal comparative studies and state its limitations.

7.0 REFERENCES/FURTHER READING

Daramola, S.O. (2006). *Research and Statistical Methods in Education*. Bamitex printing and publishing. pp.7-8.

Otuka, J.O. (2004). *Educational Reseach method*.

UNIT 3 EXPERIMENTAL RESEARCH DESIGNS

CONTENTS

1.0 INTRODUCTION

Experimental research design has a special place in research design. It enables researchers to maintain control over all factors that may affect the result of an experiment. It makes use of randomisation and the manipulation of variables which is not possible in any other design.

2.0 OBJECTIVES

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

- define an experimental research design
- state the purpose and characteristics of an experimental research
- explain the limitations of an experimental research
- identify examples of an experimental research.

3.0 MAIN CONTENT

3.1 Definition and Purpose of Experimental Research Design

In an experimental research design, you have to note the following:-

- The blueprint of the procedure that enables the researcher test his hypothesis by reaching valid conclusions about relationships between independent and dependent variables.
- Experimental research finds out the effect of manipulating some process variables by providing various treatments and latter compare with an interested group called the control group.

➢ The three variables to be taken into consideration when conducting experimental research are dependent (X), independent (Y) and intervening variables.

Purpose of Experimental Research:

- It attempts to discover relations among variables under ‘’pure’’ and uncontaminated conditions.
- It tests hypothesis derived from theories and from other previous studies.
- It builds credible theoretical systems through the processes of hypotheses testing; refinement of theories, formulation of new hypotheses related to other experimentally tested hypotheses.

3.1.1 Basics Characteristics of Experimental Research

- The experiment has complete control on the manipulation of the independent variables (i.e. the causal variables).
- The researcher has the control over the elimination of extraneous influence which may affect the result of the experiment.
- A high degree of specificity may be achieved in stating the operational definitions of the major variables to be involved in the experiment
- Result of experimental research: are precise and the research is susceptible to reliability in variance terms, the error variance.
- As a result of controlled manipulation, precise laboratory results are achieved.

3.1.2 Steps in Experimental Research

Below are some systematic steps involved in experimental research

1. Identify and define the problem in such a way that the variables under study and their relationship are clearly stated.
2. Carry out literature review relating to the problem.
3. Formulate the research hypothesis, which include deducing the consequences of the relationship between or among the variables.
4. Construction of the experimental plan of the study.
5. Assignment of the subjects to group and subsequently an assignment of experimental treatments to groups.
6. Construct and validate instrument to measure the outcome of the experiment.
7. Outline the procedure for collecting the data.
8. Conduct a pilot study to perfect the instrument or design.
9. State the outline or statistical or null hypothesis.

10. Carry out the conduct of the experiment.

11. Reduce the raw data in a manner that will produce the best appraisal of the effect which is presumed to exist.

3.1.3 Limitations of Experimental Research

- Error variance cannot be totally eliminated
- Unlike other designs experimental research design must be passed through a vigorous session of manipulation.
- There is common threat to internal validity which can lead to ambiguity in the bid to control the error variance.
- There is weakness of external validity, that is, the interaction of selection and treatment.
- Unlike other research designs, experimental research design needs an appropriate control or comparison groups for effective generalisation.

Examples of researchable topics in experimental research

include:

1. The relative effects of discussion and lecture methods on students' achievement in science.
2. The effect of teachers' reprimand on the academic achievements of anxious students.

SELF-ASSESSMENT EXERCISE

i.) Define experimental research.

ii.) List five steps involved in conducting an experimental study.

iii.) List four limitations of an experimental research.

4.0 CONCLUSION

In this unit, you have been exposed to the position an experimental research design unlike the other designs; it needs to pass through vigorous session of manipulation. Despite its limitations, its roles in social science and in educational studies are so numerous.

5.0 SUMMARY

In this unit:

- we have looked at the definition of experimental research design.
- we have also looked at the purpose, characteristics and limitations of an experimental research.
- you have also learnt about the steps in experimental research.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define experimental research.
2. List the steps involved in conducting an experimental study.
3. State four purposes of an experimental research

7.0 REFERENCES/FURTHER READING

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UNIT 4 RESEARCH INSTRUMENTS

CONTENT

1.0 INTRODUCTION

In the last units, you were taught educational research designs. In this unit you are going to study how to elicit information from a respondent though the use of a questionnaire, which is an example of a research instrument.

2.0 OBJECTIVES

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

- describe what an instrumentation and instrument in education research mean
- define questionnaire and list its types
- state basic guidelines for designing and organising a questionnaire.

3.0 MAIN CONTENT

3.1 Instrumentation in Education Research and Research Instruments

The process of selecting or developing measuring devices for gathering desired data in educational studies is described as a process of INSRUMENTATION. The measuring devices developed through the process of instrumentation are known as RESEARCH INSTRUMENTS.

In executing studies in education, certain research instruments and methods of implementation of the instruments need to be carefully selected in order to ensure the gathering of reliable and valid data, the type of research instruments to be used for particular education studies under investigation.

Types of research instruments:

1. The questionnaire
2. Interview (face to face and by telephone)
3. Observational scales.
4. Psychometric and sociometric tests

3.2 The Questionnaire as a Research Instrument

A questionnaire is a series of relevant questions or statements which are usually used to elicit information from respondents who are normally drawn from the target population of a given study. A questionnaire may contain either structured or unstructured questionnaires. The structured questionnaire, otherwise known as closed ended questionnaire has questions or statements or items in which alternative responses or options are provided by the researcher for the respondent to select from;

Example of a structured item of a questionnaire
In a period of dwindling national economy, parents should be responsible for paying the school fees of their wards at all levels of education.

Alternative Responses Provided

A. Strongly agree
B . Agree
C. Undecided
D. Disagree
E . Strongly disagree.

An unstructured questionnaire or open-ended questionnaire is one in which pre-determined responses are not provided for respondents to choose from, Example of an unstructured item of a questionnaire:
Questions: What do you consider to be the implication of open and distance learning on the future of a national economy?

SELF-ASSESSMENT EXCECISE

List four research instruments and explain two types of questionnaire.

3.2.1 Basic Guidelines for Designing and Organising a Questionnaire

There are four basic guidelines for designing and organising a questionnaire. Note the following.

- Introductory section of a questionnaire:
- Educational research is to note that every questionnaire should have an introductory section which should give a description of what such investigation is all about.
- Ordering of Questionnaire items-
  in any form of questionnaire item preparation, the items should always begin with simple items and examples of how to respond to the simple items. It is advisable to begin Questionnaire items with simple questions or items before delving into difficult items, and as much as possible, related questions should follow one another. If Questionnaire items are categorised, items in the same category should be formulated in such a way that similar items follow one after the other.

- Types of Questionnaire Required for a given study:

Whenever an educational researcher decides to use a Questionnaire as a research tool, it is advisable to decide right from the beginning, which form of the Questionnaire items (structure or unstructured items)are to be used for the investigation under study.

- Used of Language to formulate Questionnaire items:
  Educational researchers are implored to write Questionnaire items in simple and unambiguous English or Language so that comprehension of the item does not constitute problems for the intended respondents

4.0 CONCLUSION

From our discussion in this unit, you have learnt how to design and elicit information (data) for research using Questionnaire items Questionnaire as an instrument.

5.0 SUMMARY

In this unit, you have been exposed to the following:

- Research instrumentation and instrument explanation.
- Definition of questionnaire.
- Guidelines for designing and organising a questionnaire

6.0 TUTOR-MARKED ASSIGNMENT

1. Distinguish between research instrumentation and research instrument.

2. Write short note on questionnaire as a research instrument.

7.0 REFERENCES/FURTHER READING

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UNIT 5 INTERVIEW, OBSERVATION, PSYCHOMETRIC AND SOCIOMETRIC TECHNIQUES

CONTENTS

1.0 INTRODUCTION

In the last unit, you learnt research instrumentation and research instruments. This suggests that the present unit is part of the previous unit. You are therefore advised to always revise the last unit before you embark on studying the present unit.

In this unit, you will be exposed to other research instruments such as observation, interview and other data collection techniques.

2.0 OBJECTIVES

By the end of the unit, you will be able to:

- explain what an interview is, and its purpose
- state types of interview and their characteristics
- explain what observation is
- state the characteristics of observation
- explain psychometric and sociometric test as research instruments.

3.0 MAIN CONTENT

3.1 Interview Technique and its Purposes

Interview is a social relationship designed to exchange information between respondent and interviewer. The quantity of information exchanged depend on how competent and creative the interviewer is at understanding and managing that relationship. The goal is to collect data only.

The purpose of interviewing is to find out what is on the elicits mind and to assess the perspective of the persons being interviewed. It is an instrument used to gather information regarding an individual's experience and knowledge, his or her opinions, beliefs and feelings and demographics data.

3.1.2 Types of Interview and their Characteristics

No	Types of interview	Characteristics	Strength	Weaknesses
1.	Informal conversational interview	Questions emerge from the immediate context and are asked in the natural course of things; there is no predetermination of question topics or wording	Increases the salience and relevance of questions; interviews are built on and emerge from observations; the interview can be matched to individuals and circumstances.	Different information collected from different questions. Less systematic and comprehensive if certain questions do not arise ''naturally''. Data organisation and analysis can be difficult.
2.	Interview guide approach	Topics and issues to be covered are specified in advance, in outline form; interview decides	The outline increases the comprehensiveness of the data and makes data collection somewhat systematic for	Important and salient topics may be advertently omitted. Interviewer flexibility in sequencing

		sequence and wording of questions in the course of the interview.	each respondent. Logical gaps in data can be anticipated and closed. Inter views remain fairly conversational and situational.	and wording questions can result in substantially different responses from different perspective, thus reducing the comparability of responses.

3.	Standardised open-ended interview	The exact wording and sequence of questions are determined in advance. All interviewees are asked the same order basic questions in the same order. Questions are worded in a completely open-ended format.	Respondents answer the same questions, thus increasing comparability or responses; data are complete for each person on the topics addressed in the interview. Reduces interviewer effects and bias when several interviews are used. Permits evaluation users to see and review the instrumentation used in the evaluation. Facilitates organisation and analysis of the data.	Little flexibility in relating the interview to particular individuals and circumstance s; standardised wording of questions may constrain and limit naturalness and relevance of questions and answers.

4.	Closed, fixed response interview	Questions and response categories are determined in advance. Responses are fixed; respondent chooses from among these fixed responses.	Data analysis is simple; responses can be directly compared and readily aggregated; many questions can be asked in short time.	Respondents must fit their experiences and feelings into the researcher's categories; may be perceived a impersonal, irrelevant, and mechanistic. Can distort what respondents really mean or experienced by so completely limiting their response choices.

Source: Patton, Qualitative Evaluation and Research Methods (c 1990), Table 7.1 pp. 288-289. Used with permission of Sage Publication.

3.2 Observation Technique and its Characteristics

In educational research, an observational technique may be operational defined as a process whereby individuals or groups of people are ''commissioned'' to watch and record the happenings of events or even study behavioural patterns in settings of interest. It has been the prevailing method of inquiring. Observation continues to characterise all research: experimental, descriptive and qualitative.

Characteristics of a good observation include the following:

1. A carefully planned observation, in which observer knows what they are looking for and what is relevant in a situation.
2. Observers are aware of the wholeness of what is observed.
3. Observers are objective.
4. Observers separate the facts from the interpretation of facts.
5. Observations are checked and verified, whenever possible by repetition or by comparison with those of other competent observers.

6. Observations are carefully and expertly recorded.

3.2.1 Types and Uses of Observation Technique

Observations may be direct or inferential. An observation is said to be direct when the observer is involved in the first hand experiences of the happenings of given situations. But an observation is described as inferential when researcher draws inferences on the basis of the observation report supplied by another person or group of persons.

According to Okpala *et al*., Yoloye (1997), observational data could be useful in the following:

- Measuring classroom process variables
- Measuring programme implementation
- Identifying difficulties in programme use
- Identifying changes introduced by teachers
- Indentifying typical instructional pathways
- Supplementing data from other sources.

3.2.2 Observational Rating Scale

When observations are systematically planned to follow organised patterns, the observations serve as measuring instruments. Such observational measurements are usually described as observational rating scales. There are three major observational rating scales namely:

i) The category rating scale
ii) The numerical rating scale
iii) The graphic rating scale

In the category rating scale, a major variable under consideration is broken into categories from which an observer can choose to describe the characteristics of the behaviours observed or the attributes of the objects observed. For example suppose a researcher wishes to study the degree of students' participation in given lesson. The variable under consideration is students' participation. An observer may then be asked to rate students' participation in a given lesson by using this type of category item.

What is the degree of students' participation in the lesson observed? (Select only one option).

A. Very Active
B. Active
C. Merely Active
D. Passive
E. Very passive

The numerical rating scales are a kind of measurement in which numerical strength is given to different categories of the category rating scale (see example above). For instance, in the example on the degree of participation, numbers like 4, 3, 2, 1,0 may be assigned to very active, passive and very passive respectively.

For quantitative analysis, the numerical rating scale is very useful when numbers are assigned to categories; the measurements are treated as measures on interval scales (i.e. computerisation arising from numerical rating scales are treated under parametric statistics and certain statistical test such as t-test; analyses of variance, multiply regression analysis may be employed to compare computations obtained for different variables as a result of the use of the numerical rating scale.

While dealing with rating scales in observational techniques; researchers are implored to identify categories both verbally and numerically. i.e.,

Very Active	4
Active	3
Merely active	2
Passive	1
Very passive	0

Graphic rating scales are those constructed lines and bars used to represent the description of the different categories in rating scales.

SELF-ASSESSMENT EXERCISE

Briefly discuss types and uses of observation technique.

3.3 Psychometric and Sociometric Test as Research Instruments

Psychometric tests are those ‘pen and pencil tests’ designed to measure cognitive levels of developments of individuals. Psychometric tests may be in form of Academic Achievement tests, Quantitative and Verbal Aptitudes tests diagnostics tests. Psychometric test used in educational research may be adapted standardised tests or researcher designed tests.

Sociometric tests are those tests designed to study the level of attraction and repulsion of members of a given group. Sociometric test items may be in form of the example given below.

i. *With whom would you like to work, or play or sit next to attend a party?*
ii. *Name two members of your class you like best*

In educational research, sociometric tests may be used for:

a) Choice of people
b) Choice of lines of communication.

SELF-ASSESSMENT EXERCISE

Discuss the numerical and graphic rating scale.

4.0 CONCLUSION

From our discussion in this unit, it is evidenced that interview is a social relationship designed to exchange information between respondent and interviewer. In addition, observation technique, psychometric and sociometric tests are all research instruments used to collect data in educational research.

5.0 SUMMARY

In the last two units (4 and 5), you were taught how to obtain information (data) for educational research. In unit 4, you have treated research instruments and questionnaire. In unit 5, you learnt about how interview, observation, psychometric and sociometric techniques can be used in research.

6.0 TUTOR-MARKED ASSIGNMENT

1. State one purpose of conducting an interview.
2. Mention one characteristic of the interview guide approach.
3. Explain psychometric and sociometric tests as research instruments.

7.0 REFERENCES/FURTHER READING

Okpala,P.N ,Onocha,C.O& Oyedeji,O.A(1993). .Measurement and Evaluation in Education. Jahu-Uzairue: Stirling-Horden publishers (Nig.)Ltd. pp.85-102.

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MODULE 3 RESEARCH POPULATION AND SAMPLING TECHNIQUES

UNIT 1 CONCEPT OF POPULATION AND SAMPLE

CONTENTS

1.0 INTRODUCTION

Now that you are familiar with the research designs available to be used in undertaking a research project, the next task to engage in before going into the research proper is the identification of research participants/subjects /respondents. These terms are used inter changeably. Research subjects or respondents according to Nwankwo (1984) are participants being used for a research or an investigation or experiments. The subjects could be people, animals, institution, countries, states, specimens and so on. Researches can be carried out on animate and inanimate objects, all depends on the area of disciplines you have interest. Research subjects are called population.

In this unit we shall look at research subjects in open and distance learning education. Before going into techniques for getting this people let us familiarise ourselves with basic concepts of population and sample.

2.0 OBJECTIVES

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

- define population
- enumerate types of population
- distinguish between finite and infinite population
- illustrate with examples research sample.

3.0 MAIN CONTENT

3.1 Population

Population of a research is the universe of some group of people or objects in which the researcher is interested. It is a large number of people living in a geographical area, e.g. a country state, local government. Population in research transcends beyond people but includes events, animal and objects which or who are members of the target of the study. Population is limited to a well defined group within which the research findings are focused. Nworgu (1991) stated that population is defined in such a way that the results of investigation are generalisable unto it. For instance, Mr. Okezie may define his population as all Junior secondary school students in Abia State or all PGDDE students in National Open University of Nigeria. Any person that does not possess the characteristics defined is not part of the population.

3.2 Types of Population

Population can be categorised into:

(i) Target Population
(ii) Accessible population
(iii) Finite Population
(iv) Infinite Population.

Let us briefly look at them one by one.

Target population is all the members of a specified group to which the research is related while accessible population includes those elements in the group within the reach of the researcher. Take for example, target population may be Open and Distance Learners in Kaduna State, if these are ODL students within the reach of the researcher.

For finite and infinite population, when target population has definite number of elements that are countable it is said to be finite e.g. number

of JSS3 students in Oyo State. Whereas, if the population has indefinite number of elements, it is said to be infinite- e.g. number of grasses in a field. You also need to note that generalisation is more applicable validly to the accessible population than they would apply to the target population. The population should be such that it can provide the most authentic and dependable data necessary for solving problems.

A researcher may decide to study entire population when:

(i) He has a lot of time at his disposal
(ii) The population of study is small – If a population involves a very few people, institutions, or other objects, it is better to study the entire population.
(iii) Adequate human and material resources are available
(iv) It is necessary to make a complete count of entire members of the population.
(v) When topics warrant the study of a specific group and such a group is differentiated from any other group.

Also, a researcher may focus only on a portion of the population when:

(i) Members of population of the study is large
(ii) Human and material resources are inadequate
(iii) Time for the study is limited.

The characteristics of a population are called parameters. These include mean (μ), median, range, variance (σ^2) standard deviation (σ) , population correlation coefficient (R) and so on.

SELF-ASSESSMENT EXERCISE

i. Enumerate six research subjects you know.
ii. What is population?

3.3 Sample

We now take a step further to examine sample. Have you bought a clothing material before by taking its sample to the market or a supplier to bring a sample of goods to be supplied? Such a sample represents the entire cloth or goods in all ramifications in terms of quality and other features. So, also as we have discussed, population elements may be so large that the investigator requires taking a “handful” called sample to undertake his study. A sample is a smaller group or elements drawn through a definite step from a defined population. Generalisation could be made and references are drawn based on the observation. Knowledge obtained on the sample should be transferred to entire population.

Taking a sample of the population reduces time and costs that would have been spent.

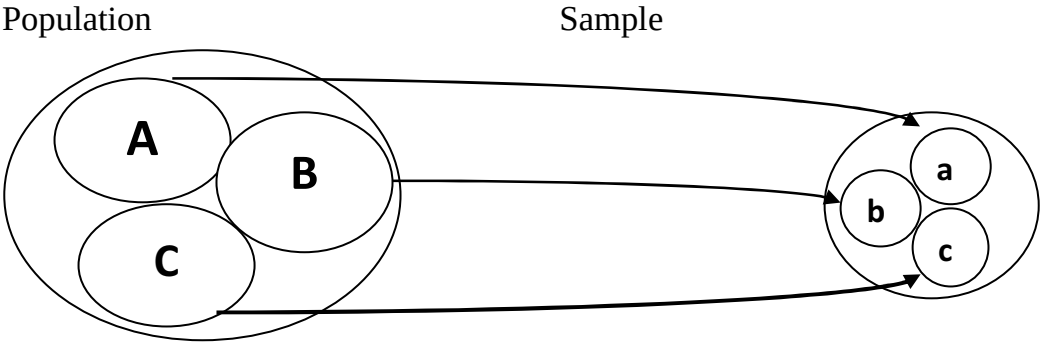

Fig.1 1: Representation of Population and Sample

Therefore, from figure 1.1 you can infer that sample is a subset of population that is studied. For instance, Samples a, b and c are taken from the population frames of A, B, and C respectively. All samples should represent the population from which they are drawn to avoid errors in the sampling. The main objective of sample designing is to keep sampling error at the lowest possible level. Sample characteristics are sample mean X, sample variance (S^2), sample standard deviation (s), sample standard error (s_x), sample correlation (R) and so on.

SELF-ASSESSMENT EXERCISE

i. Distinguish between target and accessible population.
ii. Why should a sample be representative of its parent population?

3.3.1 Need For Sampling

- Large population can be conveniently covered.
- Time, money and energy is saved.
- Helpful when units of area are homogenous.
- Used when percentage accuracy is not required.
- Used when the data is unlimited.

3.3.2 Advantages and Disadvantages of Sampling

Advantages of Sampling

- Economical: Manageable sample will reduce the cost in comparism to entire population.

- Increased speed: The processes in research, like collection of data, analysis and Interpretation of data etc take less time with samples than with the population.

- Greater Scope: The handling of data is easier and manageable when dealing with a sample. You have comprehensive scope and flexibility existing if you are using a sample.

- Accuracy: Due to limited number and area of coverage, completeness and accuracy is possible. The processing of data is done accurately yielding authentic results.

- Rapport: Better rapport is established with the respondents, which helps in validity and reliability of the results.

Disadvantages of Sampling

- Biasness: Chances of biased selection leading to erroneous conclusions are possible. Bias in the sample may be as a result of faulty method of selection of individuals or the nature of phenomenon itself.

- Selection of true representative sample: Where the problem under consideration is of a complex nature, it may be difficult to select a true representative sample; this will affect the results, which is not going be accurate.

- Need for specialised knowledge: The researcher needs knowledge, training and experience in sampling technique, statistical analysis and calculation of probable error. Not having them may lead to serious mistakes.

- Changeability of units: If the units of a population are not homogeneous, the sampling technique will be unscientific. At times, all the individuals may not be accessible or may be uncooperative. In such a case, they have to be replaced. This introduces a change in the subjects to be studied.

- Impossibility of sampling: Sometimes population is too small or too heterogeneous to select a representative sample. In such cases ‘census study’ is the alternative (Information about each member of the population) Sampling error also comes because of expectation of high standard of accuracy.

3.3.3 Characteristics of a Good Sample

A good sample should possess the following characteristics:

- ✓ A true representative of the population
- ✓ Free from error due to bias
- ✓ Adequate in size for being reliable
- ✓ Units of sample should be independent and relevant
- ✓ Units of sample should be complete precise and up to date
- ✓ Free from random sampling error
- ✓ Avoiding substituting the original sample for convenience.

4.0 CONCLUSION

You have learnt in this unit that you are to identify your target population and select the sample when carrying out a research. You will also know that these conditions at times warrant your using of the entire population. It is necessary to emphasise that if a researcher fails to choose a sample that is not a representative of the entire population, the results of the investigation will be faulted. Therefore, the need for you to understand the various sampling techniques you can employ to select sample in the subsequent units. Proper sampling enables the researcher to generalize the findings on the population.

5.0 SUMMARY

In this unit, you have learnt that research subjects are participants used for a research or an investigation you have come across; the population is universe of research subjects that researcher is interested in. Four types of population were also discussed and the explanation of sample was given. The conditions for using entire population or a portion of the population were also discussed.

6.0 TUTOR-MARKED ASSIGNMENT

1. Differentiate between population and sample.
2. Mention three characteristics each, of population and sample.
3. Explain with reason why a sample should be representative of population in all ramifications.

7.0 REFERENCES / FURTHER READING

Nwankwo, J.I. (1984). *Mastering Research in Education.* Ibadan: Claverianum Press.

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UNIT 2 SAMPLING TECHNIQUES: RANDOM AND STRATIFIED SAMPLING

CONTENTS

1.0 INTRODUCTION

In unit 1, we discussed population and sample. Population was seen as the totality of the elements in a universe on which a research is focused. You will also remember that we described sample as a sub-set of the population on which the actual research is carried out. Do not also forget our emphasis on the fact that a sample must be properly chosen so as to generalise the findings on the entire population.

In order to achieve this, it necessary to discuss various sampling techniques that you can use to get the required sample for your study. In this unit, we shall categorise sampling techniques into two: ***probability and non-probability*** also discuss random and stratified sampling.

2.0 OBJECTIVES

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

- define probability sampling
- illustrate with examples non-probability sampling
- explain random sampling
- select sample using the table of random members
- differentiate between simple and systematic random sampling.

- explain stratified sampling techniques with examples
- state 2 advantages and disadvantages each of stratified sampling technique.

3.0 MAIN CONTENT

3.1 Probability and Non-Probability Sampling

Sampling Techniques

Population and sample answer the question of who or which in research but question of how to get the sampling. Sampling techniques to be employed also depend on the research design native of the problem, type of hypotheses and research instruments.

Sampling therefore refers to taking a portion of a population or inverse as a representative of that population for instance, a school administrator who wants to find out the feelings of the students on the new school policy on discipline need not to go through all forty classes in school but may randomly select ten from each of the class levels in school.

Sampling procedures are categorised into two:

i) Probability sampling

ii) Non-probability sampling

Let us consider them one by one with the sampling techniques under each.

3.1.1 Probability Sampling

Probability sampling procedure is any method of sampling the use some forms of random selection, to which, it involves the selection of a sample from population based on the principle of randomisation or chance. Such techniques afford every member of the population equal likelihood or chance of being included in the sample. Probability sampling is more complex, time consuming and costly. There are several ways to select a probabilistic sample. These availability or sample frame, how spread the population is, how costly it is to survey members of population and how users will analyse the data. The goal of probability sampling is to put sampling errors to barest minimum and also minimise the time and cost of conducting the investigation.

Probability sampling techniques are:

i) Random sampling (simple, systematic, table of numbers)
ii) Stratified sampling
iii) Cluster sampling
iv) Multi-stage sampling
Each of these would be looked at in more detail later.

3.1.2 Non-Probability Sampling Method

Non-probability sampling is when the elements included in the sample are not determined by chance. The researcher selects those sampling units using his own opinion since elements are chosen arbitrarily. No assurance is given that each item has a chance of being included, making it impossible either to estimate sampling variability or to identify possible bias. Also, there is no way of measure the precision of the resulting sample. However, probability sampling is useful when descriptive comments about sample are required. They are quick, inexpensive and convenient. Types of sampling technique that fall into non-probability sampling are:

i) Convenience sampling
ii) Quota sampling
iii) Purposive sampling
iv) Panel sampling

3.2 Random Sampling

Below examining random sampling, let us look at the term ‘random’. Random is difficult to define. Literarily, it means haphazardness, accidental without aim or direction. Events are at random if we cannot predict their outcomes. Randomness therefore, means that there is no law, capable of being expressed in language that correctly describes or explains events and their outcomes. We cannot predict whether a coin tossed will be heads or tails.

Random sampling is the method of drawing samples from a population such that every possible sample of a particular size has an equal chance of being selected. Kerlinger and Lee (2001) also saw random sampling as that method of drawing a portion (a sample) of a population of universe in which each member of the universe has an equal chance of being selected. This definition is limited and not satisfactory. A better definition is given by Kirk (1990) as a sample drawn at random is unbiased such that no member of the population has more chance of being selected than any other member.

3.2.1 Types of Random Sampling

Random sampling can be classified into two:

- Simple random sampling
- Systematic random sampling

Let us examine them each type of random sampling one by one:

3.2.1.1 Simple Random Sampling

In simple random sampling, each member in the sample frame (the population under study) has equal and independent chance of being included in the sample. This method involves selecting at random frame the required number of subjects or elements for the sample. *For example, chosen from a bag containing 309 balls by slipping hands into the bag to pick a sample.* The probability of drawing each elements is 1/300. The process of picking from a bag is called the 'ballot' method or fishbowl technique.

Oredein identified four ways in which a random sample may be drawn:

- Tossing of the coin or throwing of the die
- By means of lottery where each item in the population is represented by a piece of paper. These are then thoroughly mixed up, and a sample of appropriate size 'n' is picked out at random without replacement.
- By means of random number tables
- Use of the computer

Using table of random numbers

Let us say we want to select a sample of 10 out of 58 schools to be used in a research, we take a list of the schools and number them from 1 to 58.

1	2	3	4	5	6	7	8	9	10	
	~~0~~	~~9~~	~~8~~	~~0~~	~~7~~	~~6~~	~~0~~	~~7~~	~~7~~	~~8~~
	0	8	2	1	2	4	7	8	7	7
	1	7	3	3	5	3	6	0	3	9
	4	6	4	7	6	1	0	3	9	9
	5	1	5	3	5	9	4	7	7	3
	6	2	2	0	8	2	2	9	7	5
	3	4	0	1	2	2	9	3	0	1
	3	1	4	8	9	0	1	3	5	1

Fig.2.1

You can enter into the table through any column, say columns 3 and 4 to take the first 10 numbers that fall within 1 to 58. The first would be 2 from column 3 and 1 from column 4 to make 21, follow by 33, 47, 53, 20, 01(1), 48, then from column 5 and 6, we have 24, 22 and 07(7) from columns 7 and 8. Therefore, schools number 21, 33, 47, 53, 20, 1, 48, 24, 22 and 7 are randomly selected sample schools to be used for the study.

3.2.2 Steps in Simple Random Sampling

Let us now put together the required steps that are necessary for carrying out random sampling. They are:

1. Identify and define the population
2. Determine the desired sample size
3. List all members of population
4. Assign all individuals on the list a consecutive number from zero to the required number, say 01 to 20.
5. Select an arbitrary number in the table of random number (close your eyes and point)
6. For the selected no, look at only the number of digits assigned to each population member e.g. if the population has 80 members you only need to use the 2 digits
7. If the number corresponds to the number assigned to one of the individual in the population then that individual is in the sample-

e.g. if a population had only 200 members and the number selected was 175, the individual assigned 175 would be in the sample. If a population had only 150 members, then 175 would be ignored

8. Go to next number in the column and repeat step 7 until the desired number of individuals has been selected for the sample.

3.2.1.2 Systematic Random Sampling

In systematic sampling, the investigator is aware of the exact population (e.g. 200) and he knows the sample size (e.g. 20). Using systematic sampling, divide the total population by sample size (200/20) to get 10. This becomes the basis for selection. List the subjects of population and alphabetically order them. You select every 10th element of the population to get the 20 samples. This type of method is easier and quicker to apply.

Steps in systematic sampling

Systematic sampling involves the following steps:

1. Identify and define the population
2. Determine the desired sample size
3. Obtain a list of the population
4. Determine what K is equal to by dividing the size of the population by the desired sample size
5. Start some random place in the population list. Close your eyes and stick your fingers on a name
6. Start at that point, take every k^{th} name on the list until the desired sample size is reached
7. If the end of the list is reached before the desired sample is reached, go back to the top of the list.

SELF-ASSESSMENT EXERCISE

1. Explain the term ‘random’
2. Using the table of random of numbers presented in this text, select five samples ranges from 8 to 50 that would be used for a research starting from column 5.

3.3 Stratified Sampling

As you have been familiar with population, sample and random sampling, another type of probability sampling techniques we shall discuss in this unit are stratified and multi-stage sampling. Let us take them one after the other.

3.3.1 Description of Stratified Sampling

Some events are naturally grouped together, for example dry and wet season events, night and day, light and darkness, things on land, water and air. Human beings could also be grouped into male/female (sex), those in rural and urban (location) muslims, Christians and tradition worshipers (religious), public and private (school type) and so on. Our knowledge of these groupings connotes the term stratification. In stratified sampling the researcher firstly divides the population into sub-groups or strata depending on the number and type of sub-groups that exist in the population and the objective of the study.

Then random samples are drawn from each strata. For instance, if the population consists of 62% of men and 38% of women, a stratified sample of 100 participants would contain 62 men and 38 women. The 62 men would be selected randomly from available group of men and 38 women would be randomly selected from the group of men. This is proportionate stratified random sampling. When this procedure is performed correctly it is more superior to simple random sampling.

Let us take another example, in a population of 3000 the relative sizes and proportions of the elements from various location strata (rural, semi-urban, urban are as contained in table below:

	Rural	**Semi-urban**	**Urban**	**Total**
Size	500	1500	1000	3000
Proportion	10%	50%	40%	100%

The number or samples from each location is calculated thus if the researcher wishes to draw a sample of 1000.

Rural = 10/100 x 1000 = 100
Semi-urban = 50/100 x 1000 = 500
Urban = 40/100 x 1000 = 400
Total sample to drawn = 1000

Out of the population of 3000, the first thing to determine is the proportion of the desired sample size (i.e. 1000) in relation to the population and multiplies the size of each stratum in the population by this proportion.

Disproportionate stratified random sampling is essentially the same as proportionate random sampling except that in the proportionate random sampling, the relative proportions of the strata in the sample do not correspond to their relative proportions in the population. Some strata may be over-represented or under-represented in the sample. This means that some strata will be assigned more weight and others weight than their respective weights in the population; or that irrespective of their weights in the population each stratum is assigned the same thing.

3.3.2 Steps in Stratified Sampling

The steps in stratified sampling are similar to those in random sampling except that selection is from sub-goings in the population rather than the population as a whole. That is, random sampling is done more than once, it is done for each sub-group stratified sampling involves the following steps.

1. Identify and define the population
2. Determine desired sample sixe
3. Identify the variable and subgroups (strata) for which you want to guarantee approximate, equal representation
4. Classify all members of the population as members of one of the identified sub-groups
5. Randomly select an appropriate number of individual from each of the subgroups, appropriate in this case meaning an equal number of individual.

A stratified sampling approach is most effective when three conditions are met:

1. Variability within strata is minimised. There should not be characteristic difference among all the elements in the same stratum. If there is any it must be very little so as to give all members in that stratum equal chance of being selected after stratification.
2. Variability between strata is maximised. One stratum needs to be unique on its own right. Characteristics of the elements in a stratum A are different from features of the elements in stratum B. Distinctiveness of each stratum is emphasised.

The variables upon which the population is stratified are strongly correlated with the desired dependent variable.

3.3.3 Advantages and Disadvantages of Stratified Sampling Techniques

Advantages

Strengths of stratified random sampling:

- It ensures greater representativeness of the sample relative to population
- It guarantees that minority section of the population are represented in the sample
- Reduction in sampling error permit greater balancing of stratified power of test of difference between strata by sampling equal numbers from strata varying widely in size.

Disadvantages

- Very difficult and time consuming
- Demands prior knowledge of the composition of the population
- Difficult if not impossible to attain
- Classification error cannot be ruled out

SELF-ASSESSMENT EXERCISE

Compute the sample elements from a population of 4,000 in each of the strata in the table below if a sample of 2,500 is to be taken in the proportion stated

	Zone A	Zone B	Zone C	Zone D	Total
Population Size	1500	800	1200	500	4000
Proportion	.40	.20	.30	.10	
Sample size					

4.0 CONCLUSION

You have discovered from this unit that sampling entails the taking of a portion of a section of population to be used as a research subject frame. In random sampling techniques, the researcher gives energy member of the population equal chance of being selected. Random sampling could take the form of simple and systematic sampling techniques. Systematic random sampling relies on arrangement of target population according

to some ordering and then selecting elements at regular interval through that ordered list. In stratified sampling techniques, the population is organized into categories called 'strata' which is sampled as an independent sub-population, out of which individual elements can be randomly selected.

5.0 SUMMARY

In this unit, you have learnt that sampling techniques could be probabilistic or non-probabilistic. Random and stratified sampling techniques were also discussed using specific examples. It was emphasized that stratified sampling is usually inculcating random sampling before the final sample are chosen.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is probability sampling technique?
2. Give three examples of non-probability sampling.
3. Explain the term random sampling.
4. Distinguish between simple and systematic random sampling.
5. How do you explain stratified sampling? Give 2 examples.
6. Enumerate 2 advantages and 2 disadvantages of stratified sampling technique.

7.0 REFERENCES / FURTHER READINGS

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UNIT 3 CLUSTER AND MULTI-STAGE SAMPLING TECHNIQUES

CONTENTS

1.0 INTRODUCTION

In the last unit, we discussed probability sampling random and stratified sampling techniques. Random sampling was divided into simple and systematic while stratified sampling was discussed with the conditions for its effectiveness. Cluster and multi-stage sampling techniques are other probability sampling techniques which will also be discussed in this unit.

2.0 OBJECTIVES

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

- explain cluster sampling
- list the steps involved in cluster sampling
- state two advantages and disadvantages each of cluster sampling
- select desired sample from target population using multi-staged sampling
- illustrate with examples cluster and multistage sampling methods.

3.0 MAIN CONTENT

3.1 Cluster Sampling

Description of Cluster Sampling

Cluster sampling randomly selected groups, not individuals. All the members of selected groups have similar characteristics. It is most useful when the population is very large or spread over a wide geographical area. Any location within which we find an intact group of similar characteristics (population members) is cluster. Examples of clusters include classrooms, market place, stadia, city, hospitals, and department stores and so on. Cluster sampling usually involves less time and expense and is generally convenient. For example, it is easier to use all Biology SSII students in several classes than several students in many classrooms or it is easier to use all the people in a limited number of city blocks than a few people in many city blocks. Cluster sampling is easier than sample random or stratified sampling but necessarily as good.

3.1.1 Steps in Cluster Sampling

1. Identify and define the population
2. Determine the desired sample size
3. Identify and define a logical cluster
4. List all clusters that make up the population of clusters
5. Estimate the average number of population members per cluster
6. Determine the number of cluster needed by dividing the sample size by the estimated size of a cluster
7. Randomly selected the needed number of clusters
8. Include all population members in each selected cluster

This sampling plan is a lot easier to apply where a large population or large geographical area is to be covered. In a way, cluster sampling method is related to deliberate sampling because the investigator has reason to believe that a particular larger population would contain a greater number of the type of cases required for the study. This sampling approach must combine other methods of random selection for it to be useful.

3.1.2 Advantages and Disadvantages of Cluster Sampling

Advantages

- More cost effective
- Allows flexibility since other forms of sampling could be introduced at various stages
- Automatic availability of large sample

Disadvantages

- Greater sampling error is associated
- Tendency of bias of the resultant sample
- Difficult to control elements from one sample unit from mixing up with elements from another sample unit.

SELF-ASSESSMENT EXERCISE

How is cluster sampling different from stratified sampling?

3.2 Multi-Stage Sampling

Multi-Stage Sampling: What it is

Cluster sampling can be done in stages involving selection of clusters within clusters. For example, a state in a geographical zone, then local governments in the state, then schools in the local government and then classrooms in the schools could be randomly selected to sample classroom for a study. This process is called multi-stage sampling. This is a complex form of cluster sampling in which two or more levels of units are embedded one in other. Using all the sample elements in all the selected clusters may be prohibitively expensive or not necessary. The technique is used frequently when a complete list of all members of the population does not exist and is inappropriate. The first stage consists of constructing the clusters that will be used to sample from. In the second stage, a sample of primary units is randomly selected from each cluster. In the following stages, in each of those selected clusters, additional samples of units are selected and so on. All individuals selected at the last step of this procedure are then surveyed. This technique is essentially the process of taking random subsamples of preceding random samples. Also, to sample household in Nigeria, first Nigeria can be divided into states which are used as a sample of states. States could be divided into local government areas, and using as a sample frame, select a sample of local governments and cities (towns) from selected Local Government Areas. We could carry on in this way until we get down to the sample of households to be interviewed.

3.2.1 Advantages and Disadvantages of Multistage Sampling

Advantages

- It reduces the large cost, time and energy associated with traditional cluster sampling
- convenience of finding the survey sample
- normally more accurate than cluster sampling for the same size sample

Disadvantages

- It is prone to sampling error in each stage of sampling
- It is not as accurate as simple random sampling if the sample is the same size
- More testing is difficult to do

3.2.2 Steps in Multi-Stage Sampling

1. Identify and define the population
2. Determine the desired sample size
3. Divide the entire population into sample frame at first stage
4. At second stage, population unit are randomly selected from selected cluster in (3)
5. From each of the selected cluster in (4) select another sub-cluster for another stage
6. Randomly select needed number of clusters from where the final sample would be picked.

SELF-ASSESSMENT EXERCISE

With specific examples, illustrate how you would use multi-staged sampling technique.

4.0 CONCLUSION

It is evident from this unit that cluster sampling technique utilises the opportunity of selecting groups of sample that have similar characteristics from a particular location. It is easily applied to a large population. Also, you have learnt from this unit that multi-staged sampling is a form of cluster sampling in which stages of selection are followed before arriving at the final sample to be used for a study.

5.0 SUMMARY

The key points of this unit which you must have effectively learnt are:

- Cluster sampling is a form of probability sampling
- Cluster sampling fosters possible selection of groups of population in which data collected on groups may avoid introduction of confusion by isolating members
- Multi-staged sampling can also make up probability sample by random at stages and within groups
- All complexity in form of sampling and standard errors should be removed before a researcher could successfully apply multi-staged sampling method.

6.0 TUTOR-MARKED ASSIGNMENT

1. Briefly explain the term cluster sampling.
2. Enumerate steps that are involved in cluster sampling.
3. Select a sample of 1000 from target population of ODL Nursing students in South-west, Nigeria.
4. Identify two advantages and disadvantages each of cluster sampling and multi-staged sampling.

7.0 REFERENCES/FURTHER READING

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UNIT 4 NON-PROBABILITY SAMPLING TECHNIQUES

CONTENTS

1.0 INTRODUCTION

As was noted in Units 1 and 2 of this Module, sampling techniques could be categorised into probability and non-probability. In those units, we discussed in detail simple random, systematic, stratified, cluster and multi-staged sampling as examples of probability sampling techniques. In this unit therefore, we shall move on to discuss non-probability sampling techniques

2.0 OBJECTIVES

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

- define purposive and quota sampling
- distinguish between accidental and panel sampling
- explain how to use quota sampling in obtaining sample.

3.0 MAIN CONTENT

3.1 Purposive/Judgmental Sampling

In purposive sampling, specific elements which satisfy some predetermined criteria are selected based on researcher's judgement. He exercises this judgement in relation to what he thinks will constitute a representativeness of such samples (Nworgu 1991). Purposive sampling sample is the one that is selected based on the knowledge of a population and purpose of the study. The researcher picks sample that the met the specific characteristics of the purpose of the study.

Researcher using purposive sampling exercise his judgment in relation to what he thinks constitute a representative sample with respect to the research purpose. For instance, an investigator might purposively use all S.S.S. 2 students in his study because of the following reasons:

(i) they have completed substantial aspects of their syllabus
(ii) They are more mature
(iii) They are not preparing for any external examination.

Advantages and Disadvantages of Purposive Sampling

Advantages

- It is relatively cheaper and easier
- It ensures that only those elements those relevant elements are included

Disadvantages

- Some limitation is imposed on any generalisations made
- It requires a great deal of knowledge of the characteristics of the population

3.2 Quota Sampling

Have you heard of quota system in Nigeria especially in the areas of admission into federal institutions and employment into Federal government ministries? Each state is given a place of admission or employment and the position is filled by those members of the state and none else. Also, a researcher might ensure that specific elements will be included in the sample having particular characteristics of interest to him/her. Selected individuals come to fill a quota by characteristics proportional to populations.

When quota sampling is involved, the data gatherers are given exact characteristics and quota of persons to be used. He includes any category of the population that is of particular interest to him. For example, a research may want to sample 25 working women with children under the age of 16 or 30 working women with no children under the age of 16. When quota sample is used, people who are less accessible are under-represented.

There are two types of quota sampling:

i) Proportional
ii) Non-proportional

In proportional quota sampling, the researcher wants to represent the major characteristics of the population by sampling a proportional amount of each. For instance, if he knows the population has 40% boys and 60% girls and he wants a total sample of 100, he will continue sampling until he gets those percentages and then stop.

Non-proportional is less restrictive, the researcher specifies the minimum number of sample unit he wants in each category. He is not concerned with having numbers that match the proportions in the population.

Advantage and Disadvantage of Purposive Sampling

Advantage

- It ensures selection of adequate number of subjects with appropriate characteristics

Disadvantage

- It is not possible to prove that the sample is representative of designated population

3.3 Convenience/Volunteer/Accidental Sampling

Convenience sampling is also referred to as accidental sampling and basically involves including in the sample whoever happens to be available at that time or either asking for volunteer. The only determining factors are the researchers. Convenience and economy in terms of money and time. For example, a television reporter who just interviewed any person that comes his ways in a particular area is doing accidental sampling. Also, suppose you want to study the effectiveness of study-habit training on the achievement of ODL fresh students. You ask for volunteers from NOUN students class and 60 students volunteer. Of course they are not representative of all new students. They may be students who are not doing well academically but wish that they were. If you send a questionnaire to 200 randomly selected people and ask the questions “how do you feel about questionnaires; suppose 80 responded and all 80 indicate that they love questionnaires. Should one then conclude that the group from which the sample was selected loves

questionnaire? No. The 120 who did not respond may not have done so because they hate questionnaire.

3.4 Panel Sampling

Panel sampling is the method of first selecting a group of participants through a random sampling method and then asking that group for the same information again several times over a period of time. Therefore, each subject is given the same survey at two or more points, each period of data collection is called a 'wave'. It allows estimates of changes in the population for example with regard to chronic illness of students to study stress and to weak academic performance. This method could also be used to inform researchers about within-person health changes due to age. This method is usually used for longitudinal research in which a researcher is interested in changes that happen to the group over a period of time.

SELF-ASSESSMENT EXERCISE

Differentiate between quota and disproportionate, stratified random sampling.

4.0 CONCLUSION

In this unit we discussed typical examples of non-probability sampling techniques such as purposive, quota, accidental and panel which involve to a large extent non-random selection of sample.

5.0 SUMMARY

This unit emphasised and explained various non-probability sampling techniques. We saw differential characteristics such as:

- Purposive sampling hand-pick subjects on the basis of specific characteristics
- Quota sampling select sample as they come to fill a quota by characteristics proportional to the population
- Accidental or convenience sampling either ask for volunteers or the consequence of not all those selected finally participating or a set of subjects who just happen to be available.
- Panel sampling is the selection of a group of subjects that have desired traits and using them over a period of time to examine charges of interest in them.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define the following: (i) purposive sampling (ii) quota sampling

2. With specific examples, explain accidental and snowball sampling techniques

3. Differentiate between proportional and non-proportional quota

7.0 REFERENCES/FURTHER READING

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UNIT 5 SNOWBALL SAMPLING

CONTENT

1.0 INTRODUCTION

Research findings are dependent, as much as possible, on the extent to which the population of the study is defined and on the adequacy and choice of the sampling procedure used in the study. Since snowball sampling technique is another way sampling non-probability sample, we shall discuss this concept in this unit in relation to open and distance education so that you will understand what it is meant and also appreciate its importance.

2.0 OBJECTIVES

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

- describe snowball sampling
- explain types of snowball sampling
- List and explain advantages and disadvantages of snowball sampling.

3.0 MAIN CONTENT

3.1 Meaning of Snowball Sampling

Snowball sampling is a non-probability sampling technique that is used by researchers to identify potential subjects in studies where subjects are hard to locate. It is also called chain referral sampling. Researchers use this sampling method if the sample for the study is very rate or is limited to a very small subgroup of the population. This type of sampling technique works like chain referral. After observing the initial subject,

the researcher asks for assistance from the subject to help identify people with a similar trait of interest.

The process of snowball sampling is much like asking your subjects to nominate another person with the same trait as your next subject. The researcher then observes the nominated subjects and continues in the same way until the obtaining sufficient number of subjects.

For example, if obtaining subjects for a study that wants to observe a rare disease, the researcher may opt to use snowball sampling since it will be difficult to obtain subjects, it is also possible that the patients with the same disease have a support group; being able to observe one of the members as your initial subject will then lead you to move subjects for the study.

3.2 Types of Snowball Sampling

1. Linear snowball sampling

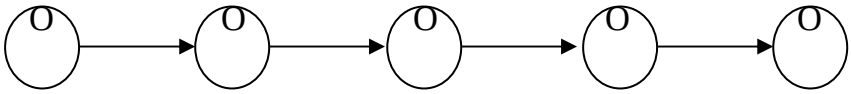

Fig.5.1

The chain is in straight form that is one subject identified the other and the other identifies the next subject.

2. Exponential non-discriminate snowball sampling

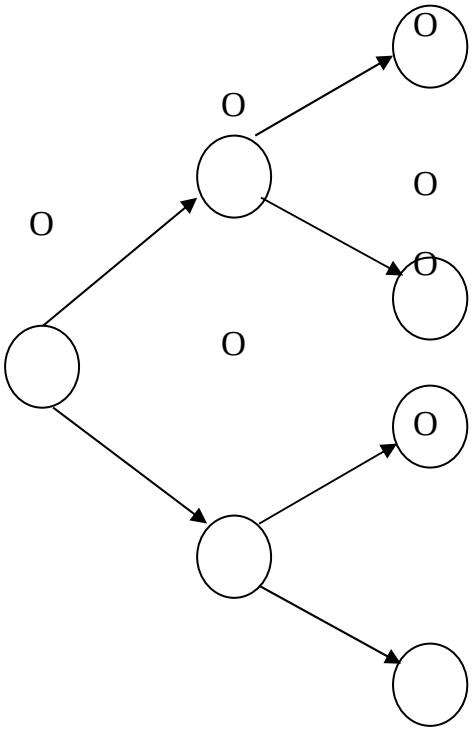

Fig.5.2

This form is in branching formation. The first subject identifies two subjects and those two subjects identified two-two subjects each. The branching continues till the required numbers of subjects for the study is gotten.

3. Exponential discriminative-snowball sampling

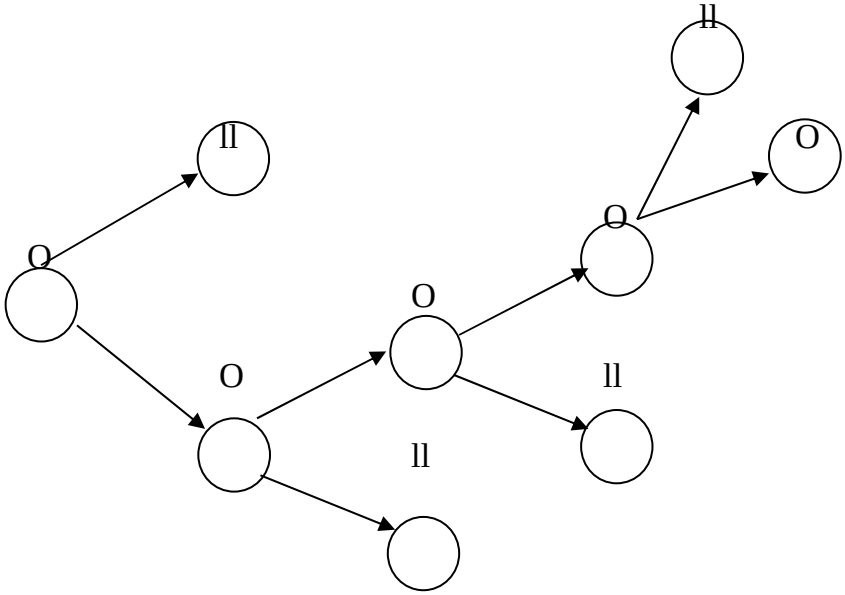

Fig.5.3

This is in the form by which one subject identified two subjects and one will fits in for the purpose of research and the other will not fit in. like it was depicted in the diagram.

3.3 Advantages and Disadvantages of Snowball Sampling

Advantages of Snowball Sampling

1. The chain referral process allows the researcher to reach populations that are difficult to sample when using other sampling methods.
2. The process is cheap, simple and cost efficient.
3. This sampling technique needed little planning and fewer workforce compared to other sampling techniques.

Disadvantages of Snowball Sampling

1. The research has little control over the sampling method. The subjects that the researcher can obtain rely mainly on the previous subjects that were observed.

2. Representativeness of the sample is not guaranteed. The researcher has no idea of the true distribution of the population and of the sample.
3. Sampling bias is also a fear of researchers when using this sampling technique. Initial subjects tend to nominate people that they know well, because of this, it is highly possible that the subjects share the same traits and characteristics, thus, it is possible that the sample that the researcher will obtain is only a small subgroup of the entire population.

4.0 CONCLUSION

From this unit, you have seen that some populations we are interested in studying can be hard-to-reach/or hidden. These include populations such as drug addicts, homeless people, individuals with AIDS/HIV, prostitutes and so forth. Such populations can be hard-to-reach and/or hidden because they exhibit some kind of social stigma, illicit or illegal behaviours, or other trait that makes them a typical and/or socially marginalised. Snowball sampling is a non-profitability based technique that can be used to gain access to such populations.

5.0 SUMMARY

In this unit, you have learnt that snowball sample is a non-profitability sampling technique that is appropriate to use in research when the members of a population are difficult to locate. A snowball sample is one in which the researcher collects data on the dew members of the target population he or she can locate, then ask those individuals to provide information needed to locate other members of that population whom they know.

Different types of snowball sampling techniques viz 1. Linear; 2. Exponential non-discriminate and 3. Exponential discriminate snowball were discussed. So also advantages and disadvantages of snowball sampling technique were discussed.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is snowball sampling technique?
2. Explain the different types of snowball sampling technique.
3. What are the advantages and disadvantages of snowball sampling techniques?
4. Identify at least four (4) research areas where snowball sampling technique will be appropriate.

7.0 REFERENCES/FURTHER READING

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UNIT 6 SAMPLE SIZE AND SAMPLING ERRORS

CONTENTS

1.0 INTRODUCTION

We have mentioned sample size before in units 1 to 4; but it needs to be discussed in much more detail to really describe all that is associated with it. Also, sampling is affected by common errors that affect its acceptability and effective use. You will learn some errors in research that could impede your effective sample in particular and research in general. You will also learn in this unit, some considerations that are necessary for result-oriented sampling process.

2.0 OBJECTIVES

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

- explain the terms sample size
- mention factors that necessitate the choice of large sample
- enumerate the criteria for chosen a sample
- compute adequate sample size from a population
- identify sampling errors
- list non-sampling errors that can affect the quality of a research
- describe some considerations for effective sampling

3.0 MAIN CONTENT

3.1 Sample Size

Description of Sample Size

Oredein (2004) defines sample size as the number of units in a sample. Nwankwo (1984) had earlier conceptualised sample size as relating to the representativeness of the sample to the population. But sample size alone (in terms of number) does not constitute representativeness. For example, it is better to have a representative sample of 30 to a population of 500, than to have a large unrepresentative sample of 150 to a population of 500. The answers to the question of representativeness of the sample size may be found in a reasonable approximation of the value the researcher is seeking to estimate and the precision with which he wishes to estimate the expected value.

Another small samples have their own advantages as in case studies, and sometimes where complex techniques of evaluating behavior (like role playing or interview) yet it remains true that the larger the sample, the smaller the sampling error. Therefore, it is always safer to increase the sample size whenever it is possible to do so. The sample size is function of three factors;

(i) Maximum allowable sampling effort
(ii) The number of standard error units associated with the level of confidence specified.
(iii) The standard deviation of the population parameter of the trait of interest.

3.1.1 Criteria for Choosing a Sample

Akuezuilo (2002) emphasised that the following factors should be put into consideration before a sample size is chosen:

(i) The larger the sample size the smaller the magnitude of sampling error.
(ii) Non-experimental studies should have the magnitude of sampling error.
(iii) When sample groups are to be subdivided into smaller groups to be compared, the researcher initially should select enough samples so that the subgroups are of adequate size for his or her purpose.
(iv) In mailed questionnaire studies, because the percentage of responses may be as low as 20 to 30 percent, a large initial sample mailing is indicated.

(v) Availability of subjects and cost of sampling exercise will also help to determine the sample size.

3.1.2 Factors Necessary for Large Sample Size

Large sample size might be necessary due to the following factors:

1. A large number of uncontrolled variable are interacting without prediction and it is desired to minimise their separate effects from a large variety of situations representing different account and combinations of these variables.
2. The total sample is to be divided into several subsamples and these sub-sample categories are the actual units of comparison.
3. The population is made up of a wide range of variables and characteristics and small sample would run a high risk of missing or misrepresenting many of these differences.
4. Differences in the results are expected to be small and it is important to insure against losing these differences in the distracting interferences of the inevitable errors variance.

   For greater emphasis, whenever there is some question or doubt about sample size, the best approach is to select as large a sample as practicable since the larger the sample, the smaller the sampling error.

Sample size also depends on the sample fraction. Sample fraction is the proportion of the total population that is constituted by the sample.

For example: If the total population of the teachers is 3000 sample size of 300, the sample from is calculated thus:

$$n(p) = 3000$$

$$n(s) = 300$$

$$S_f = \frac{n(s)}{n(p)} = \frac{300}{3000} = \frac{1}{10}$$

The sample fraction (S_f) is 1/10

3.2 Error Components in Research

Sampling Errors

Sampling error is the difference between sample estimation and its corresponding population parameter. Sample errors are related to the sample design itself and estimators used. The most common measure of sampling errors is the variance of an estimate or derivatives thereof. The derivative is the standard error, which is simply the square root of the variance. Sampling errors occur when samples are unlikely to have characteristics identical with each other or with the population.

Sampling errors include;

(i) Selected bias: when the true selection probabilities differ from those assumed in calculating results
(ii) Random sampling error: Random variation in the results due to the elements in the sample being selected at random.

Non-Sampling Errors

These types of error may induce systematic bias in the estimates, as opposed to random errors caused by sampling errors. Oredein (2004) identify five types of such errors. They are:

(i) Imperfection in the sampling frame when the population frame from which the sample is selected does not comprise the complete population under study or includes foreign elements.
(ii) Errors imposed by deviation from theoretical sample design and field work procedures. Examples: non-response, among households selected or person interviewed and so on
(iii) Improper wording questions – misquotations by the interviewer, misinterpretation and other factors that may cause failure in obtaining the intended response.
(iv) Unforeseen systematic biases in the sample selection cause by the field work procedures
(v) Data processing errors- This include errors rising incidentally during the stages of response recording data entry and programming.

Other non-sampling errors manifest in form of

(i) Over-coverage- Inclusion of data from outside of the population

(ii) Under-coverage- Sampling frame does not include elements in the population.
(iii) Measurement error- When respondents misunderstand a question, or find it difficult to answer.
(iv) Processing error- Mistakes in data coding
(v) Non-response – failure to obtain complete data from all selected individuals.

3.3 Consideration in Sampling

The goal of the researcher should be to obtain a sample that is as much representative of the population as possible. However, this goal is not always easy to realise in practice due to practical limitations such as time, money and insufficient knowledge of the population. In the face of these obstacles, the researcher has to take some factors into full account while making decisions relating to sampling, Nworgu (1991) identified these factors.

(i) Availability of Fund

The researcher has to choose such a sample that is possible to obtain with the fund available to him. If obtaining a sample entails a higher cost than the researcher can afford, there is no way he can have such a sample.

(ii) Population

The size of the population has to be taken into account while sampling. Decision to study the entire population or a part of it depends on the population size. The larger the population, the larger the number of elements to be include in the sample.

(iii) Accessibility

The accessibility of the elements is another important consideration sampling. The decision to include an element in the sample must take account of the accessibility of such an element.

4.0 CONCLUSION

In this unit, we have discussed that sample size must be the true representativeness of the entire population to be used for a research. It was also noted that larger sample size reduces sampling errors. Four factors were identified as necessary for using large sample size. We also saw sampling errors as the difference between a sample estimate and its corresponding population parameter. Sampling errors include selection

bias and random sampling errors. You were also taught in this unit that there are also some non-sampling errors which inflict systematic bias in the estimates for a research and also emphasised that the goal of researcher to get an acceptable sample is hindered by fund availability, population size and accessibility.

5.0 SUMMARY

The key focus of this unit you have just completed was how to determine your sample size when the sample fraction of the target population is considered. We have also considered factors that are necessary for choosing a large sample size. Error components (sampling and non-sampling) were discussed. Some considerations in sampling and to make it affective and efficient were looked at. These sampling techniques are essential for you to undertake research projects in open and distance learning.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe sample size with examples.
2. Enumerate four factors that necessitate the choice of large sample.
3. If 30% of the 5000 population is to be used as sample for a survey,what is the sample size of the survey?
4. List 3 examples each of sampling and non-sampling errors.
5. What are considerations for effective sampling?

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UNIT 7 VALIDITY AND RELIABILITY OF RESEARCH INSTRUMENTS

1.0 INTRODUCTION

In this module, we have been talking about research subjects, concept of population and sample in terms of probability and non-probability sampling techniques. An instrument is a measuring device. It could be a questionnaire, observation or test measuring intelligence or achievement. You have to note that if a study is very well designed but uses faulty instruments, the findings would be completely invalidated.

It is therefore very important that when you design a very good study, you will match it with appropriately and carefully developed and validated instruments. The instrument has to be valid and reliable to serve the purpose of the study. In this unit, you will be studying the validity and the reliability of the instruments which you construct for your data collection in research.

2.0 OBJECTIVES

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

- explain measurement error
- define validity of an instrument
- discuss the types of validity
- explain the various ways of estimating reliability.

3.0 MAIN CONTENT

3.1 Measurement Error

Errors in measurement could arise from family instruments, incorrect, interpretations of the values obtained or instability in the behaviour of the respondents. These errors could be systematic or random. A systematic error can occur when the error are very frequent and are made in one direction away from the true score. Take for instance, your table clock in your office which is always adding time or always faster than the true or an achievement test which keeps reporting very high scores for every respondent.

Random errors can occur when measurement values deviate from the true score and as frequently in one direction as another. If you take the clock as an example, you will see that sometimes the clock will gain time and lose time on the other times. Random error can be attributed to chance factors. It should as much as possible be estimated and adjusted for or its sources eliminated.

In the case of the clock in your office, how do you think you can eliminate the error? Your answering has be to improve the working condition or to replace it. An instrument should as much as possible be designed to measure the true score. The degree to which an instrument measures the true scores is an indication of two very important factors. These are reliability and validity. We are going to look at these in the next two sections.

Meanwhile, note that the degree of random error is inversely related to the degree of reliability while the degree of non-random error is inversely related to the same variable or when you use a large sample in your study, random errors tend to average out over repeated measurements. Therefore, to improve reliability of an instrument, the best strategy is to use multiple measures, multiple measurements and multiple investigators. This is what the triangulation theory of Denzin (1978) specified.

3.2 Validity

You have been reading about validity and reliability. What is validity? Validity involves the extent to which an instrument measures what it purports to measures. It deals with basic honesty – honesty in the sense of doing what one promises to do. It is concerns entirely the purpose, means employed and means actually achieved. In all these, there is always a gap in between purpose and practice. The reliability is measured in degree – it can be low, average or high. In research it is the results of the research instrument and not the instrument per see. Consequently, we shall discuss four types of validity and they are:

1. Content validity
2. (a) Criterion – related validity
   (b) Concurrent validity
3. Construct validity
4. Feel validity

3.2.1 Content Validity

It is an important and useful criterion of an instrument, for example achievement test is pre-test and post-test. It is a measure of the degree to which an instrument (test, questionnaire, etc) covers a representative sample of content areas. It is expected to cover the cognitive, effective and psychomotor areas of the subject – matter (content). It is our concern in content validity to determine whether the sample is representative of the larger universe which is supposed to represent, so as to establish the content validity of a research instrument the following procedures can be followed:

(i) List the subject content areas and expected behaviours and/or skills. For achievement test in Mathematics for Basic 8, you can consult the mathematics curriculum, syllabus for Upper Basic School. Analyse the syllabus topic by topic in relation to expected behaviours/skills.

(ii) Weighting of topics and objectives. The test-developer must decide the weighting of each test item realising the objectives of instruction the curriculum and time to be spent on testing and

(iii) a table of specifications and construction of test-items. This is the test blue print and it is a two-way grid which relates the content areas and objectives/skills. With appropriate allocation of weight to area and the skills/objectives. The table must be able to contain a number of test items in each cell. This concept will be properly death with in subsequent module.

Note that a test/instrument that is content valid for one purpose may, completely, be inappropriate for another. Also, an instrument with established content validity for measuring learners' achievement at the end of a course may not be valid from the point of view of content for diagnosing learner-weaknesses. Basically, content validity is subjective as it depends on the assessors estimate of the degree of correspondence between what is taught (or what should be taught) and what is tested. It requires a careful examination of the stated objectives of the course in terms of course content and target abilities or skills and a study of the size and depth of realisation of their coverage. This cannot be objectively measured.

3.2.2 Construct Validity

Construct means tract or ideas developed in the mind to define, identify or explain psychological attributes such as intelligence, creativity, aptitude, perception, attitude, study-habit, reasoning ability, etc. Construct validity is the degree to which a research instrument measures a specific trait or psychological trait. For example, if a researcher is interrelated to measure students school attitude, the constructed instrument on school attitude will be administered on sample of students collect and analyse their responses. The research will try to find out whether the instrument measures attitude to school subjects or any other construct or whether it actually measure's school attitude. If the instrument measures school attitude then the research was discovered a theory for explaining variance in individual scores. Construct validity is complex and can be difficult to determine. According to Onocha and Okpala (1995) some methods of obtaining construct validity are:

(i) analysing of the mental precisions required by the instrument/test item;

(ii) experimental interventions

(iii) correlation with other instruments;

(iv) factor analysis

(v) internal consistency, etc.

These methods will not be discussed in detail (see other texts). Finally, a test will have construct validity if its scores vary in ways suggested by the theory underlying the construct. In other words, construct validity is the degree to which one can under certain construct in a psychological theory from the test/instrument score.

3.2.3 Criterion Related Validity

This can be objectively measured and declared in terms of numerical indices. It focuses on a set of external criterion as its yardstick of measurement, and it may be a date of concurrent information of a future performance.

(a) Concurrent validity implies (i) two tests/instruments whereby one whose validity is being examined and the one with proven validity (which is taken as the criterion) and they are supposed to cover the same content area of a given level and the same objectives (ii) the population for both the tests/instruments remains the same and the two tests/instruments are administered in apparently similar environment and (iii) the performance data on both the tests/instruments are obtainable almost simultaneously (which is not possible in the case of predictive criterion).

(b) Predictive validity: It refers to the degree to which the results of a test forecast or predict future behavioural change of the respondent. The basis of this is that success in the criterion measure will be related to the predictive measure.

The correlation of a concurrent criterion yields concurrent validity while the correlation of predictive criterion also yields predictive validity. The concurrent validity serves the purpose of measuring proficiency the predictive validity is meant for predictive function.

The concurrent criterion of psychological tests/instruments, especially tests of intelligence whereas predictive criterion is crucial in selection and placement test in bank recruitment, schools and mission, etc.

3.2.4 Face Validity

This refers to the extent the instrument/test seems logically related to what is being tested. Face validity may not be dependable. A test may look right without being rational or even useful. For example, a teacher prepared test/instrument in a course containing 10 items and appear to have face validity but on detailed analysis of the items it only contains items in just half of the content area, that is, it lack content validity. It is not a useful approach to determine validity of an instrument/test.

3.2.5 Factors Influencing Validity

Certain factors may influence instrument/test results. Y validity, an/a instrument/test measured what is expected to measure but some factors may limit the validity and they are:

(i) Factors inherent in the instrument. Such factors of unclear instructions, vocabulary, level of difficulty of items ambiguous items inappropriate time, etc.
(ii) Factors inherent in the instrument administration, scoring, possible unhealthy physical and psychological environment which may have adverse effects on the respondents. If the test/instrument room is congested, poorly ventilated, poor sitting arrangement noise factor (physical and psychological) – such factors could have negative effect on the respondents.
(iii) Factors affecting the validity co-efficient – validity is influenced by the spread of scores, nature of the group and attitude to be measured, etc.

SELF-ASSESSMENT EXERCISE

An achievement instrument of high content validity cannot be a construct valid instrument for diagnostic instrument. Why?

3.3 Reliability

Reliability refers to the degree of consistency between two sets of measure or observations obtained with the same instrument of its equivalent. While validity we have discussed relates to the questions of what to test, the reliability relates to the question of accuracy with which the instrument is measured. If a researcher were to measure the same instrument twice the logical expectation would be for the researcher to get more or less the same score both the times, but this does not happen always. Differences in scores do happen always. Differences in scores do occur and they are likely with every repetition of an instrument.

The difference may be due to:

(i) trait instability – characteristic changes across time.
(ii) Sampling inconsistency – particular questions on instrument may affect the score.
(iii) Administrator inconsistency – instrument – timing or testee report with test tester
(iv) Lack of objectivity in terms of:
(a) The item
(b) Response which the item permits.

(c) Scoring method used

Error Score: Two types are possible: systematic error and random error when an error is consistent, it is a systematic error whereas errors which do remain the same on every occasion of measurement.

As regards reliability Grondlund (1981) stated the following clarifications:

(i) Reliability refers to the results obtained with an evaluation of an instrument and not to the instrument itself. It is appropriate to speak of the reliability of the instrument 'scores' or of the 'measurement' than of the 'test' or of the 'instrument'.
(ii) That instrument scores are not reliable in general an estimate of reliability always refers to a particular type of consistence.
(iii) Reliability is a necessary but not insufficient condition for validity. A low reliability can restrict the degree of validity.
(iv) Reliability is primarily statistical in nature – reliability coefficient.

There are four types of reliability. They are:

3.3.1 Test-Retest Method

This is obtained by administering a test/instrument twice to the same group with a considerable time interval between the two administrations and correlating the two sets of scores thus obtained. The correlation coefficient obtained provides the estimate of the reliability and a measure of stability over a period of time. The time interval between administration of the instrument/test should not be to short or too long. The appropriate time-interval will be dictated by the type of instrument and the utility of the results.

3.3.2 Equivalent Forms

As a result of the problem of time – interval for a second administration of the instrument the method of equivalent forms was developed. In this method, two parallel or alternate form of test or research instrument will be administered concurrently to the same students. The scores of the two sets are obtained and the correlation coefficient of the two is computed and the result is interpreted as the reliability coefficient. The coefficient provides a measure of equivalence.

3.3.3 Measures of Internal Consistency

The methods discussed above are concerned with consistency between two sets of scores obtained on two different test-administrations whereas this method of internal consistency takes into consideration the scores obtained on a single test administration. The estimate of reliability obtained through these methods is mostly indices of homogeneity of item in the test or the extent of overlap between the responses to an item and the total scores.

3.3.3.1Split-Half Method

This is a measure of internal consistency. It requires the administration of a single test instrument to the students once then the items of the instrument are split into two parts.

In other words, the total set of items is divided into halves. The scores on the halves are correlated to obtain the estimate of reliability. You can split the items using odd and even numbers, or randomly dividing the items into two groups, etc. You can see that the result you get from it for a half test. Therefore, it is corrected using the spearman-brown formula:

$$r = \frac{2 \times r_{1/2}}{1 + r_{1/2}} \quad \text{or} \quad r_t = \frac{nr_s}{1 + (n+1)r_s}$$

where r = reliability of the whole test
$r_{½}$ or rs = reliability f the half test

3.3.3.2 Kuder Richardson (KR 20, KR 21)

So as to measure internal consistency Kuder-Richarson developed two formulae KR 20 and KR 21 which helps to solve the problem of split half measures. The items in the instrument are homogenous and possess inter-item consistency. The formulas are:

$$\text{KR 21}\ r_{xx} = \frac{n}{n-1}\ 1 - \left(\frac{x(n - \bar{x})}{nSx^2} \right)$$

$$\text{KR 20}\ r_{xx} = \frac{n}{n-1} \left(1 - \frac{\sum PQ}{Sx^2} \right)$$

where n = number of items on test
$\bar{x}$ = mean of the total test
S_x^2 = variance of the total test
$P = \frac{\text{Number of persons answering item correctly}}{\text{Number of persons taking the test}}$
$Q = \frac{\text{Number of prsons answering item wrongly}}{\text{Number of persons taking the test}}$

		q = 1 + p
PQ	=	variance of a single item scored dichotomously
ΣPQ	=	summation sign indicating that pq is summed over all items

It is easier to compute KR 21 than KR 20. The application of these formula is possible when the scoring of items is binary (making their 1 or 1-ges or no items). When the items are of equal difficulty (facility, value), p is constant for all items, KR 20 can be assessed. KR method is not appropriate for effective measures and also where spread is involved.

3.3.3.3 Cronbach Alpha

We have used KR estimates when the scoring of items is not Dichotomous (Yes or No) however, when the scoring is not dichomous, as I a test consisting of essay questions or in affective measures of scales agree, undecided or disagree, the formulae developed by Cronbach can be used to get the reliability estimate. This is known as Cronbach alpha and is the same as KR 20, except for the fact that pq is replaced by Si^2 where Si^2 is the variance of a single item. The formula is:

$$\text{alpha} = \frac{n}{n+1}\left(1-\frac{Si^2}{Sx^2}\right)$$

where Si^2	=	variance f a single score
S_x^2	=	variance of the total instrument
n	=	number of items

The measure mutually compares the variance of any single item with the variance for the entire test. It is therefore suggested that there should be at least five questions in the test to make the measure meaningful.

3.3.4 Scorer Reliability

The issue of estimating scorer reliability does not arise in the context of objective tests but for instruments such as essay type tests, projective personality test and creativity tests, there is consideration likelihood that scorer error would occur. For such instruments there is need to establish scorer reliability in addition to the usual estimates of reliability. In this method, test instrument are score independently by two or more different scorers. The set of scores return for an individual are correlated using Pearson Product Moment Correlation coefficient or we use the Spearman Brown prophecy formula:

$$r_{xx} = \frac{kr}{1+(k-1)r}$$

where rxx is predicted scorer reliability of a rest with k number of readers

r = reliability estimate of a single reader
k = numer of readers

Factors which can affect reliability measures include the following:

(i) Time-interval and length of test: The time interval of administration in the equivalent forms and the length of time in the internal consistency.

(ii) Spread of scores
(iii) Speed
(iv) Objectivity
(v) Difficulty of test
(vi) Discriminating level of test

3.3.5 Usability of Instrument

Having discussed validity and reliability of instrument, usability raises mostly questions of feasibility and ease with regards to instrument construction, administration, evaluation, interpretation and padegogical application. According to Unocha and Okpalla (1995) the usability of an instrument would depend on:

1. simplicity of instructions;
2. time required for administration;
3. ease of scoring;
4. ease of interpretation and application; and
5. availability of equivalent or comparable form.

Self Assessment Exercise

1. What is reliability of an instrument?
2. What are the methods of estimating reliability?

4.0 CONCLUSION

In this unit, you learnt the methods of validity of your instruments and also the ways to estimate the reliability. From this, you have seen that it is very important to make your instruments valid and reliable. This is because any instrument which is properly constructed to have adequate validity and reliability and also properly administered will yield quality data that will make your research report to stand a good chance of being well presented.

5.0 SUMMARY

So far in this unit, we have discussed two main concepts: validity and reliability of instrument and the different approaches within each, the context in which each of these approaches become relevant and the procedures by which the evidence of validity and reliability of an instrument are to be established. Finally, we mentioned usability of an instrument and factors on which the usability of an instrument depend.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is validity?
2. Describe the two types of criterion related validity.
3. What are the two types of measurement error?
4. "Reliability is a necessary but not sufficient condition for validity" Explain.
5. Name three measures of internal consistency and explain one of them with example.

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MODULE 4 STATISTICS IN EDUCATIONAL RESEARCH

UNIT 1 INTRODUCTION TO STATISTICS

1.0 INTRODUCTION

In the previous modules/units, you worked through the different methods of collecting data in research. The question is; what do you do with this seemingly unmanageable bulk of data? This question will take us to 'Data Analysis', which we shall describe "as the process of organising and summarising data in order to provide answers to the research questions or test hypotheses stated in the study".

This process, most of the times, involves the use of statistical procedures to summarise and describe the characteristics of samples and populations of the study.In this unit, we shall first look at the meaning of statistics, the types of statistics and organisation of data.

2.0 OBJECTIVES

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

- define the concept statistics;
- explain the types of statistics;
- organise a set of scores under (a) sequencing, (b) frequency distribution table, (c) bar chart.

3.0 MAIN CONTENT

3.1 Meaning of Statistics

Statistics, as a word, has different shades of meaning. These meanings can be in the plural form or singular form.

(i) **It is regarded as a state arithmetic:** In this case, it involves observing, recording and computing the amount of resources, financial, human and material, available to a government for the purpose of governance or war. Every government needs accurate statistics to make governance easier.

(ii) **Statistics can be regarded as pieces of information:** Statistics imply data or pieces of information e.g. the age of Bayo, the height of Ike, the weight of Audu, the number of students in Mr. Bassey's class, the number of classes in JSS. 1, Federal Government College, Okigwe. Others are: number of accidents on road A for a year, number of candidates employed by company B in 1999, the number of workers retrenched during the reform programme.

(iii) **Statistics as summaries of information:** In this case, it can be used as summaries of information about a small group of individuals selected from large group for the purpose of investigating the large group. This is called sample statistics. This can be in the form of sample size, mean, median, variance, standard deviation, mode, etc. Each of these is regarded as a statistic.

(iv) **Statistics as Mathematical function or models:** In this case, it is used for comparison of two or more samples. In other words, it can be used for pair wise differences, ratios of 2-test, 2-score, t-score, t-test, f-test etc are examples.

(v) **Statistics as academic discipline:** In this case, it is regarded as a subject or field of study, in which case, it is an aspect of applied mathematics.

According to Spiegel (1972), statistics is concerned with scientific methods for collecting, organising, summarising, presenting and

analysing data as well as drawing valid conclusions and making reasonable decisions on the basis of such analysis.

You can get so many definitions of statistics from so many textbooks. Since this course is not purely on statistics, we shall look at statistics as the science of decision making in the face of uncertainties. Look at Hays (1973). He says that statistics serves in two capacities:

(1) It gives methods for organising, summarising and communicating data, and
(2) It provides methods for making inference beyond the observations.

In summary, statistics involves observation, collection of data, organization of data, presentation of data, analysis of data, interpretation of data and decision making. You may wish to note that statistics, when used as a subject, is not the plural of statistic. A statistic is a measure which we obtain by observing the characteristics of the sample. You have learnt that we study a sample in order to make inferences about the population.

Therefore, the characteristic of the population which we estimate from a sample characteristic or statistic is called a parameter. The mean of a sample is 50. The mode of the distribution is 45. It means that 50 is a statistic, 45 is also a statistic. You can give other examples.

3.2 Types of Statistics

You may have heard about different types of statistics, such as Correlation, probability, parametric, non-parametric, etc. statistics. All these have been grouped into two major types. These are descriptive and inferential statistics. In this section, you will read a brief presentation of these major types.

3.2.1 Descriptive Statistics

This can be described as a type of statistical application which is concerned with the organisation and presentation of data in a convenient; usable and communicable form. Spiegel (1972) described it “as the set of methods serving the functions of organising, summarising and communicating data.

You can use descriptive statistical methods when you are interested in merely describing the characteristics of the group or the sample of study. It means that the descriptive analysis which you make will not generalise beyond the particular group or sample observed. In the same

way, conclusions drawn from the study are limited and apply only to that group of study.

3.2.2 Inferential Statistics

These are statistical methods used for arriving at conclusions extending beyond immediate data. They are the phases of statistics which can be used to deal with conditions under which conclusions are drawn about a larger group based on data collected from some smaller group or groups chosen from and related to the larger group.

Inferential statistics can be described as a statistical procedure which makes use of sample statistics to make inferences about the population parameters. It involves the process of sampling that is representative of the population. It makes use of the aspect of inferential statistics called parametric statistics which are powerful tests that make use of the normal probability model, or making comparison involving the setting up of confidence limit, setting up of the degree of freedom etc. We shall discuss this later.

3.3 Benefits of the Study of Statistics

When you study statistics, you stand to derive some general benefits. These benefits focus on the useful knowledge, skills, capabilities or dispositions which you will acquire from the study of, or training in statistics. They vary, according to the extent and level of study, or training in the subject. Some of these benefits include that the study of statistics will enable you to:

1. Acquire' knowledge and skills in observation, collection, organisation, communication, analysis of data, drawing inferences from the analysis of data and making sound decisions;
2. Make meaningful contributions to local, national or international debates on topical issues;
3. Read, understand and interpret communicated data, follow inferences drawn therefrom and appreciate decisions made consequent upon the inferences drawn;
4. Successfully execute empirical research. No reasonable or worthwhile empirical research can be carried out or reported without statistics for answering research questions, testing hypotheses or taking decisions and making predictions;
5. Read, interpret and make use of research reports or articles;
6. Follow and critique contributions to debates presented with facts and figures;
7. Acquire the skills and techniques for estimating, predicting and projecting into the future based on the previous and present data;

8. Draw sound conclusions based on some pieces of information that are probable or not quite certain.

SELF-ASSESSMENT EXERCISE

i. What is statistics?
ii. What are the two types of statistics?

3.4 Organisation of Data

Data collected in education can be from various sources and can be in various forms, such as: opinions, scores/marks, frequencies, verbal etc. The data can be organised or arranged to make them meaningful. In this section, we shall look at sequencing, tables, frequency distribution tables, bar charts, etc.

3.4.1 Sequencing

This involves arranging the data in order of magnitude - ascending or descending order. See example below:

Example 1:

Given that the test scores of 10 students in statistics are:

8, 9, 2, 5, 7, 6, 4, 9, 8, 3.

This could be arranged in ascending order thus:
2, 3, 4, 5, 6, 7, 8, 8, 9, 9 or in descending order thus; 9, 9, 8, 8, 7, 6, 5, 4, 3, 2.
If the data consists of names, they can be arranged in alphabetical order. If they consists of objects, events, animals, etc. they can be arranged according to kinds, species, groups etc.

3.4.2 Tables

A table can be regarded as a two-dimensional representative of statistical information or data. Tables can be simple or complex as shown in the examples on the enrolment of pupils in central school Umuihi from 2000 to 2007, and Distribution of Mathematics teachers in Okigwe Zone in the year 2006.

Example 1

Table 1.1: Pupils' Enrolment in Central School, Umuihi, 2000 - 2007.

S/N	Year	Boys	Girls	Total
1.	2000	. 200	170	370
2.	2001	210	165	375
3.	2002	230	170	400
4.	2003	220	175	395
5.	2004	240	180	420
6.	2005	225	170	395
7.	2006	242	182	424
8.	2007	250	200	450

Example 2

Table 1.2: Distribution of Mathematics Teachers in Okigwe Education Zone

S/N	Local Government	No, of Teachers
1.	Ehime Mbano	525
2.	Ihitte / Uboma	425
3.	Isiala Mbano	600
4.	Obowo – Etiti	400
5.	Onuimo	325
6.	Okigwe	425
	Total	**2,700**

3.4.3 Frequency Distribution Table

A frequency distribution table shows the number of times each score, value or item occurs in a distribution. Ft consists of two columns - one for the scores/items and the other for the frequency.

Example 3:

The scores of some students in a Mathematics test are given below. Present the scores in a frequency table.

10, 15, 18, 12, 14, 15,20, 15, 16, 11, 12, 14, 19,20, 17, 18, 15, 13, 11, 12, 19, 13, 10, 14, 17, 19, 16,15,15,15.

Table 1.3: Frequency Distribution Table

S/N	Score	Tally	Frequency
1.	10	\\	2
2.	11	\\	2
3.	12	\\\	3
4.	13	\\	2
5.	14	\\\	3
6.	15	~~\\\\~~ \\	7
7.	16	\\	2
8	17	\\	2
9.	18	\\	2
10.	19	\\\	3
11.	20	\\	2
			30

Note that when you tally, each number tallied is neatly cancelled to avoid confusion.

3.4.4 Grouped Frequency Distribution

Some of the times, the number of scores may be so large that it becomes necessary to group several scores together. A group of score values form a class interval.

Example 4:
Present the scores below in a grouped frequency table.
55, 62 60, 50, 52, 58, 55, 60, 51, 55, 68, 55, 47, 39, 58, 42, 47, 42, 48, 55, 48, 46, 55, 51, 58, 65, 52, 35, 54, 55, 52, 56, 46, 65, 53, 34, 48, 50, 39, 59, 53, 52, 33, 48, 65, 60, 36, 68, 45, 62, 59, 60, 33,40,61,38.
In order to determine the interval or class size:

(i) Find the range. This is given by the highest score minus the lowest score. From the scores, we have 60 - 33 = 27.
(ii) Determine the number of groups. It has to be between 10 and 20.
(iii) Divide the range by the number e.g. 27 ÷ 12 = 3 (approximate)
(iv) Draw a table and tally the scores according to groups.

Table 18.4: Grouped Frequency Distribution Table

S/N	Class Interval	Tally	Frequency		
1.	66-68	\\	2		
2.	63-65	\\\	3		
3.	60-62	~~\\\\~~ \\	7		
4.	57-59	~~\\\\~~	5		
5.	54-56	~~\\\\~~ \\\\	9		55, 62 60, 50, 52, 58, 55, 60,
6.	51-53	~~\\\\~~ \\\	8		51, 55, 68, 55, 47, 39, 58,
7.	48-50	~~\\\\~~ \	6		42, 47, 42,
8.	45-47	~~\\\\~~	5		48, 55, 48, 46, 55, 51, 58,
9.	42-44	\\	2		65, 52,
10.	39-41	\\\	3		35, 54, 55, 52, 56, 46, 65,
11.	36-38	\\	2		53, 34,
12.	33-35	\\\\	4		48, 50, 39, 59, 53, 52, 33, 48, 65, 60, 36, 68, 45, 62, 59, 60, 33, 40, 61,38.

7.0 REFERENECS/FURTHER READING

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UNIT 2 METHODS OF REPRESENTING DATA AND MEASURES OF CENTRAL TENDENCY

1.0 INTRODUCTION

In last unit, you were exposed to the concept of statistics and organisation of data. You also read through the bar chart which is a graphical way of representing data. In this unit, you will continue to be exposed to other ways of representing data. These include pie chart, histogram, frequency polygon and ogive. We will also look at the measures of central tendency. As this is not a complete course on statistics, we may not be so detailed in the presentations.

2.0 OBJECTIVES

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

- explain how to construct a pie chart using given data;
- discuss how to construct histogram;
- draw a composite table and construct a frequency polygon;
- draw a composite table and construct an ogive;
- calculate the mean, median and mode of a given data.

3.0 MAIN CONTENT

3.1 Pie Chart

This is used to represent both discrete and continuous data. It involves using a circle to represent a set or groups of items or scores. Each group or item is represented by a sector of the circle. The angle subtended at the centre by the sector is proportional to the frequency of the items o scores represented. It implies that the total frequencies of the set are represented by 360°.

Example 1:

Construct a pie chart to represent the data below:

The distribution by local government area of Basic Technology teachers in Okigwe Zone is a follows:

EHIME = 60, IHITTE/UBOM = 50, ISIALA = 65, ONUIMO = 40, OBOWO = 35, OKIGWE = 30.

To construct the pie chart:

i. Find the angle that is subtended at the centre by each group:

(a) EHIME = $\frac{60}{280} \times \frac{360}{1}$ = 77.14^0

(b) IHITTE/UBOMA = $\frac{50}{280} \times \frac{360}{1} = 64.29^0$

(c) ISIALA = $\frac{65}{280} \times \frac{360}{1}$ = 83.57^0

(d) ONUIMO = $\frac{40}{280} \times \frac{360}{1}$ = 51.43^0

(e) OBOWO = $\frac{35}{280} \times \frac{360}{1}$ = 45.00^0

(f) OKIGWE = $\frac{30}{280} \times \frac{360}{1}$ = 38.57^0

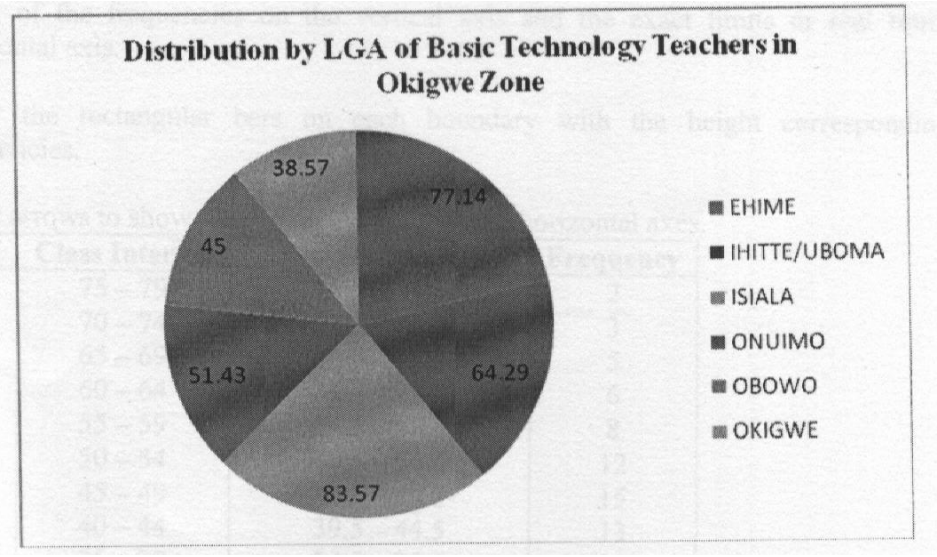


Fig.2.1

ii. With the aid of a pair of compasses, any convenient radius, draw a circle.

iii. Using your protractor, mark out the angles corresponding to each group or category o items, to the nearest degree.

i. Label the sectors of the circle corresponding to the items.

3.2 Histogram

In the last unit, you studied the bar chart, which is used mainly for the representation of discrete data. In the construction, you noticed that the rectangles do not touch each other. The histogram is used to represent data on a frequency distribution table like the bar chart. It is made up of rectangular bars of equal joined to one another, and it is used for continuous data. At the vertical axis, we have the frequencies and at the horizontal, we have the corresponding class intervals. The difference between the two is that, for bar chart the class intervals are used while for histogram the exact class boundaries arc used. There are two exact class boundaries—upper and lower exact class boundaries. These are obtained by subtracting 0.5 from the upper boundary and adding 0.5 to the lower boundary. Alternatively, for the exact lower limit of the first group (20 - 24), we have $\frac{19+20}{2} = 19.5$

And for the exact upper limit = $\frac{24+25}{2} = 24.5$

Example 2
Using the data below, construct a histogram:

Class Interval	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75 - 79
Frequency	3	5	8	10	13	15	12	8	6	5	3	2

To construct a histogram:

1. Compose a composite table having the class interval, the exact class limits, and the frequencies.
2. Choose suitable scales and draw the vertical and horizontal axes.
3. Mark of the frequencies on the vertical axis and the exact limits or real limits on the horizontal axis.
4. Draw the rectangular bars on each boundary with the height corresponding to the frequencies.
5. Draw arrows to show what is on the vertical and horizontal axes.

S/N	**Class Interval**	**Real Exact Limit**	**Frequency**
1.	75-79	74.5 - 79.5	2
2.	70-74	69.5 - 74.5	3
3.	65-69	64.5 - 69.5	5
4.	60-64	59.5-64.5	6
5.	55-59	54.5-59.5	8
6.	50-54	49.5 - 54.5	12
7.	45-49	44.5-49.5	15
8.	40-44	39.5-44.5	13
9.	35-39	34.5-39.5	10
10.	30-34	29.5 - 34.5	8
11.	25-29	24.5 - 29.5	5
12.	20-24	19.5-24.5	3
			90

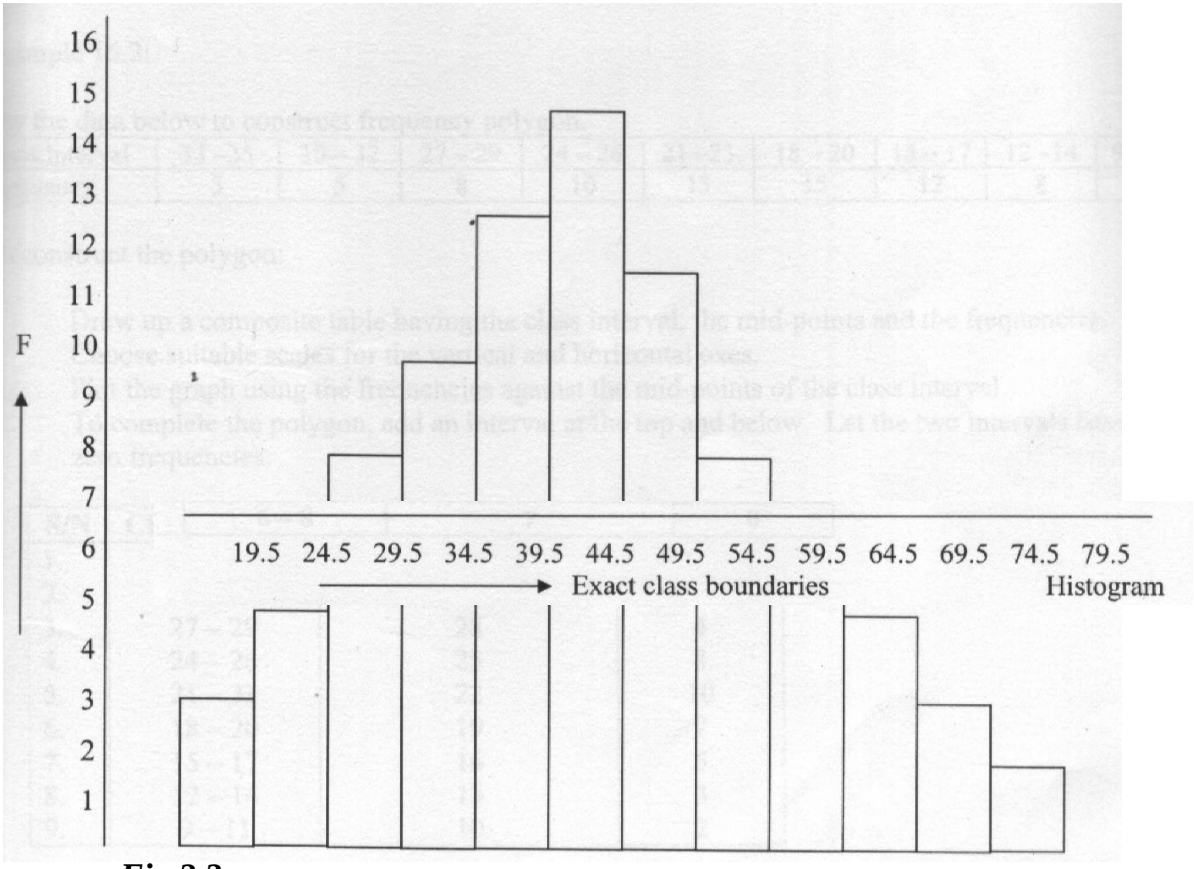


Fig.2.2

SELF-ASSESSMENT EXERCISE

An Education student of NOUN spent a total of ₦30,000.00 as follows:

Registration	=	₦5,000.00
Course materials	=	₦10,000.00
Examinations	=	₦5,000.00
Transportation	=	₦3,000.00
Stationeries	=	₦2,000.00
Diskettes and CDs	=	₦1, 000.00
Note books	=	₦2,500.00
Typing of assignments	=	₦l,500.00

Represent these expenses in a pie chart.

3.3 Frequency Polygon

This is a line graph plotted using the frequencies against the mid-points of the class intervals.

Example 2
Use the data below to construct frequency polygon.

Class Interval	33-35	30-32	27-29	24-26	21-23	18-20	15-17	12-14	9-11
Frequency	3	5	8	10	13	15	12	8	6

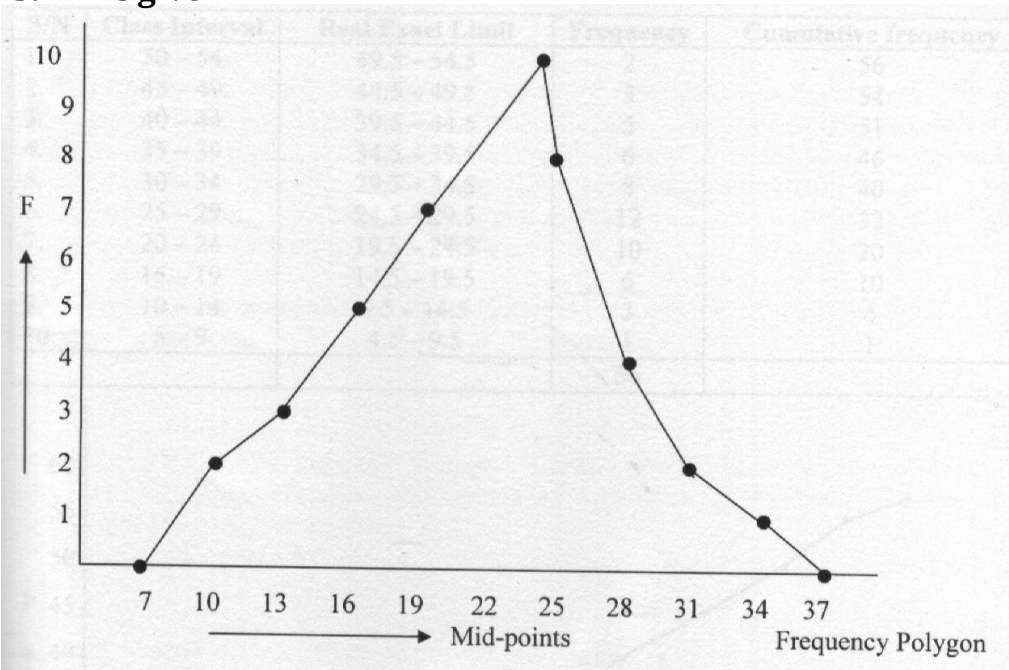
To construct the polygon:

(i) Draw up a composite table having the class interval, the mid-points and the frequencies.
(ii) Choose suitable scales for the vertical and horizontal axes.
(iii) Plot the graph using the frequencies against the mid-points of the class interval.
(iv) To complete the polygon, add an interval at the top and below. Let the two intervals have zero frequencies.

S/N	**Class Interval**	**Real Exact Limit**	**Frequency**
1.	33-35	34	9
2.	30-32	31	2
3.	27-29	28	4
4.	24-26	25	8
5.	21-23	22	10
6.	18-20	19	7
7.	15-17	16	5
8.	12-14	13	3
9.	9-11	10	2
	6-8	**7**	**0**

Fig.2.3

3.4 Ogive



This is a graph which involves the use of a smooth curve to join the Cartesian coordinate plots of cumulative frequencies against the real class boundaries. In other words, instead of the frequencies, it makes use of the cumulative frequencies. The graph gives shape like shallow 'S'.

Example 4:

Using the score groups below, draw an ogive or cumulative frequency curve:

Class Interval	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54
Frequency	1	3	6	10	12	8	6	5	8	6

To draw the ogive:

i. Compose a composite table having the class boundaries, the exact class limits, frequencies and cumulative frequencies.
ii. Choose a suitable scale to accommodate the highest cumulative frequency on the vertical axis and the class boundaries on the horizontal axis.
iii. Plot the points on the cumulative frequencies against the corresponding class boundaries. iv. Join with a smooth curve.

S/N	**Class Interval**	**Real Exact Limit**	**Frequency**	**Cumulative frequency**
I.	50-54	49.5-54.5	2	56
2.	45-49	44,5-49.5	3	54
3.	40-44	39.5-44.5	5	51
4.	35-39	34.5-39.5	6	46
5.	30-34	29.5 - 34.5	8	40
6.	25-29	24.5-29.5	12	32
7.	20-24	19.5-24.5	10	20
8.	15-19	14.5-19.5	6	10
9.	10-14	9.5-14.5	3	4
10.	5-9	4.5 - 9.5	1	1
			56	

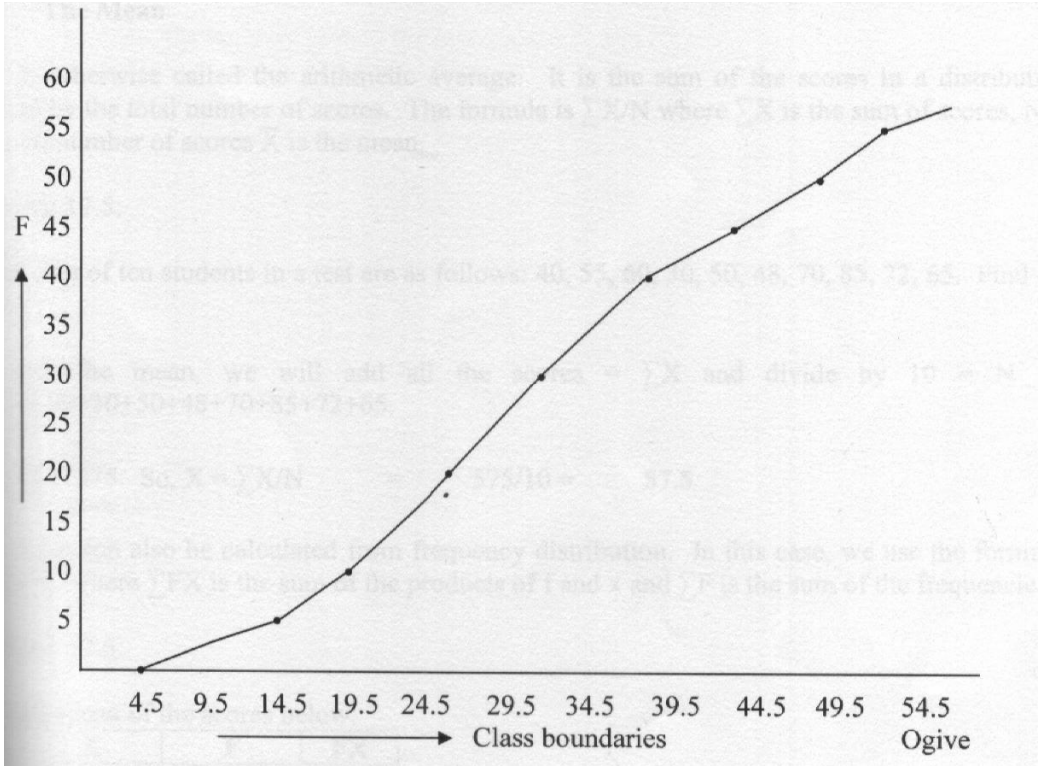


Fig.2.4

SELF-ASSESSMENT EXERCISE

Using the data below;
(i) Construct a frequency polygon, and
(ii) Construct an ogive.

Class Interval	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36	37-39	40-42	43-45
Frequencies	2	4	6	10	7	12	8	5	0	4	3	1

3.5 Measures of Central Tendency

In the last sections, you studied the graphical method of representing data. The measures of central tendency provide convenient way of summarising data. This method involves finding a single measure which is typical of a set of scores. This measure of value can be used to 'capture' or represent a whole set of scores in such a way that it becomes the representative score of the whole distribution of scores. As a teacher, you will need to be using it very often in describing the performance of your students in tests and examinations.

In statistics, the three most common of all the measures available for use are mean, median and mode. Let us discuss them in that order.

3.5.1 The Mean

This is otherwise called the arithmetic average. It is the sum of the scores in a distribution divided by the total number of scores. The formula is ΣX/N where ΣX is the sum of scores, N is total number of scores $\overline{X}$ is the mean.

Example 5:

The scores often students in a test are as follows: 40, 55, 60, 30, 50, 48, 70, 85, 72, 65. Find the mean.

To find the mean, we will add all the scores = ΣX and divide by 10 = N i.e. 40 + 55+60+30+50+48+70+85+72+65.
∴ ΣX = 375. So $\overline{X}$ = ΣX/N = 575/10 = 57.5

The mean can also be calculated from frequency distribution. In this case, we use the formula: ΣFX/ΣF, where ΣFX is the sum of the products of f and x and £F is the sum of the frequencies.
Example 6:
Find the mean of the scores below:

S/N	**X**	**F**	**FX**
1.	30	2	60
2.	20	4	80
3.	15	4	60
4.	25	3	75
5.	10	8	85
6.	8	2	16
7.	5	6	30
8.	21	2	42
9.	12	1	12
10.	24	5	120
		37	**575**

(i) Complete the table by finding the corresponding FX i.e. FXX;
(ii) Add up F to find ΣF;
(iii) Add up FX to get ΣFX;
(iv) Divide ΣFX by ΣF - ΣFX/ΣF = 575/37 - 15.5

The mean can also be calculated when grouped frequency distribution is given.

Example 7:

Use the data given below to calculate the mean:

Class Interval	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Frequency	2	5	6	7	10	6	3	2

(i) Complete the table by getting the mid-points X, and FX;
(ii) Use the same formula $\overline{X} = \Sigma FX/\Sigma F$.

S/N	**Class Interval**	**Mid-point (X)**	**F**	**FX**
1.	60-64	62	2	124
2.	55-59	57	3	171
3.	50-54	52	6	312
4.	45-49	47	10	470
5.	40-44	42	7	294
6.	35-39	37	6	222
7.	30-34	32	5	160
8.	25-29	27	2	54
			47	1807

$\Rightarrow \overline{X} = 1807/41 = 44.07$

You have seen that the mean can be calculated from both grouped and ungrouped data, using different methods. One of these methods is called the assumed mean method. It is called the short-cut.

Example 8:
Find the mean using the data on e.g. 7.

S/N	**Class Interval**	**Mid-point (X)**	**F**	**X^1**	**FX^1**
1	60-64	62	2	4	8
2	55-59	57	3	3	9
3	50-54	52	6	2	12
4	45-49	47	10	I	10
5	40-44	42	7	0	0
6	35-39	37	6	-1	-6
7	30-34	32	5	-2	-10
8	25-29	27	2	-3	-6
			47		17

(i) Take away group mark as the assumed mean, and code it 0 as shown in column X^1.
(ii) Code every other mark above from 1, 2, 3 etc. and below -1, -2, etc.
(iii) Find the FX^1 and sum up.
(iv) Use the formula $AM + (\Sigma FX^1/\Sigma F)^i = \overline{X}$.

$\Rightarrow \overline{X}$ = 42 + (17/41) = 42 + + 2.073 = 44.073
= 44.07

3.5.2 The Median

This is the score in the distribution above and below which 50% of the scores lie. It is the middle score which divides the set of scores into two equal halves. In order to get the median, the scores must be arranged in an ordering -ascending or descending.

Example 9:

Find the median of the sets of scores:

(a) 9,7, 15,10, 11,8,2,4,3.
(b) 5, 9, 8, 7, 3, 2, 4, 6, 5, 8.

In example (a), simply arrange in ascending order. By this, we have: 2, 4, 5, 7, 8, 9, 10, 11, 15. By counting, the middle number, which is 8 is the median.

In example (b), you will notice that the number is even. You will therefore arrange in order, by counting, the two middle numbers are taken, added and divided by two.
We have:

2, 3, 4, 5, 5, 6, 7, 8, 8, 9.

The median is $\frac{5+6}{2} = \frac{11}{2}$ = 5.5

When grouped data are given, the median is calculated using the formula $\ddot{X} = L + \frac{(N/2 - cfb)^i}{fw}$

where L is the lower boundary of the median class;
N is the number of scores;cfb is the cumulative frequency below the median class; fw is the frequency within the median class.

Example 10:
Use the data below to find the median:

S/N	Class Interval	F	FX
1.	85-89	1	52
2.	80-84	2	51
3.	75-79	3	49
4.	70-74	5	46
5.	65-69	7	41
6.	60-64	8	34
7.	55-59	10	26
8.	50-54	6	16
9.	45-49	5	10
10.	40-44	4	5
11.	35-39	0	1
12.	30-34	1	1
		52	

(i) N/2 = 52/2 = 26
(ii) Find the class where 26 lies in the cummulative frequency i.e. 55 - 59. This is the median class.
(iii) $\ddot{X} = L + \frac{(N/2 - cfb)^i}{fw} = 54.5 + \frac{(26-10)^5}{10}$

$= 54.5 + \frac{(10)^5}{10} = 54.5 + 5$

$= 59.5$

3.5.3 The Mode

This is the most frequently occurring score or scores in a distribution, It is the most frequent score which can be easily determined by inspection. But in some distributions, you may have two modes. This is called bimodal; any distribution with more than two modes is called multi-modal.
Now, let us look at how to find the modes in the examples below:

Example 11:

Find the mode in the distribution below:
20, 30, 21, 45, 30, 25, 33, 35, 30, 22, 29, 30.
By inspection, you will see that 30 appeared 4 times. It is the mode because no other score appeared up to that.

Example 12:
Find the mode in the frequency table given below:

X	10	9	8	7	6	5	4	3	2	1
F	1	2	4	5	8	6	4	3	1	1

Again, by inspection, you will see that the highest occurring frequency in the above distribution is 8, and the value is 6. Therefore, 6 is the mode.

For a grouped data, the mode is calculated using the formula below:

$$\ddot{X} = L + \frac{(d^1)^i}{d^1 + d^2}$$

where L is the exact lower limit of the modal class;
d^1 is frequency of the modal class minus frequency of the class preceding or before the modal class;d^2 is frequency of the modal class minus frequency of the class immediately after the modal class.

Example 13:

Find the mode in the frequency table given below:

S/N	Class Interval	F
1.	85-89	3
2.	80-84	3
3.	75-79	8
4.	70-74	10
5.	65-69	12
6.	60-64	7
7.	55-59	5
8.	50-54	2

(i) Locate the modal class i.e., 65 - 69.

(ii) Using the formula $L + \frac{(d^1)^i}{d^1 + d^2}$ = 2

where L = 64.5, i = 5, d^1 = 12 - 7 - 5, d^2 = 12 - 10,

(iii) $\ddot{X} = 64.5 + \frac{(5)^5}{5+2}$ $64.5 + \frac{(5)^2}{7}$

= 64.5 + 3.571 = 68.07

SELF-ASSESSMENT EXERCISE

i. Define mean, median and mode.
ii. Find the mean, median and mode of the distribution given below: 10, 7, 8, 9, 6, 9, 3, 2, 9, 5, 1.

4.0 CONCLUSION

You have noticed that data by themselves convey little or no meaning until they are summarised and described. Some methods of representing data have been presented and the measures of central tendency, which form the central reference value that is usually close to the point of greatest concentration of the measurement, and which may in some sense be thought of typify the whole set, have also been presented. In the next unit, we shall look at other statistical measures.

5.0 SUMMARY

In this unit, you have been able to go through the other methods of representing data which you started in unit sixteen of this module. You have seen that the pie chart uses a circle to represent a set of data or groups of items. In other words, it can be used for both discrete and continuous data. You also went through the histogram, which is made up of rectangular bars of equal width joined to one another, It is used for continuous data. The frequency polygon is a line graph plotted using the frequencies against the mid-points of the class intervals.

The ogive uses the cumulative frequencies against the exact "class boundaries. We have two types of ogives - 'less than' ogive and 'greater than' ogive. You have equally worked through the measures of central tendency. The three measures are the mean, the median and the mode. You have seen how to calculate these measures. In the next unit, we shall look at other measures.

6.0 TUTOR-MARKED ASSIGNMENT

Find the mean, the median and the mode of the data given below;

Class Interval	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Frequencies	1	2	3	4	5	6	8	4	3	2	1	1

7.0 REFERENECS/FURTHER READING

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UNIT 3 MEASURE OF VARIABILITY OR SPREAD

CONTENT

1.0 INTRODUCTION

In the last unit, you worked through the measures of central tendency. In addition to those measures, researchers are also interested to know how the scores are spread or scattered in the distribution.

So the measures of variability indicate the degree to which a set of scores differs from each other in the distribution. These measures present a measure of homogeneity within the group of scores.
In this unit, we shall look at the range, the quartiles, the percentiles, the variance and the standard deviation.

2.0 OBJECTIVES

After working through this unit, you will be able to:

- find the range in a given set of scores;
- explain and find the quartiles in a distribution;
- find the percentiles in a given set of scores;
- calculate the variance in a given set of scores;
- calculate the standard deviation in a distribution.

3.0 MAIN CONTENT

3.1 The Range

This is the simplest and crudest measure of variability which measures the distance between the highest and the lowest scores in a distribution of scores. It is calculated by subtracting the lowest score from the highest score in the distribution of scores, plus one.

Example 1:

Find the range of the scores below:
30, 45, 20, 32, 70, 85, 90, 44, 60.

You will notice that the lowest score is 20 and the highest score is 90. So, $X_h - X_L + 1 = 90 - 20 + 1 = 71$. The range is 71.

You would have seen that the range is affected by the two extreme scores. Therefore, it is an unstable and unreliable method of determining the spread of scores. Because of this limitation, it is seldomly used as an indicator of the spread.

3.2 The Quartiles

These are score points or values which subdivide a given distribution into four equal parts. In other words, the number of scores in anyone of the four groups is equal to the number of scores in any other of the remaining three groups.

There are only three quartiles for any given 'distribution. These are the first quartile Q_1, second quartile Q_2 and third quartile Q_3. This can be illustrated below;

3.2.1 Calculation of the Quartiles

The quartiles can be calculated in a grouped data using the formula

$$Qi = L + \frac{\left[i(N/4) - cfb\right]^c}{fw}$$

Where i = 1, 2, 3, (i.e. the quartiles)
N = Σf = sample size
L = lower class boundary of the quartile class
cfb = cummulative frequency below the quartile class
fw = frequency of the quartile class
c = class interval size.

Example:

Find Q_1 and Q_3 in the distribution below:

S/N	Class Interval	F	
1.	50 – 54	1	34
2.	45 – 49	2	33
3.	40 – 44	2	31
4.	35 – 39	5	29
5.	30 – 34	8	24
6.	25 – 29	6	16 ←
7.	20 – 24	4	10
8.	15 – 19	3	6
9.	10 – 14	2	3
10.	5 – 9	1	1
		34	←

Step: (i) Find the cumulative frequencies (CF)

(ii) Divide 34 by 4 = $\frac{34}{4}$ = 8.5

(iii) Apply the formula $Q_1 = L + \frac{(i(\frac{N}{4}) - cfb)^c}{fw}$

For Q_1: 8.5 lies in the class 20 – 24

$\therefore$ 20 – 24 is the quartile class.

So, L – 19.5, fw = 4, cfb = 6

Then, $Q_1 = L + \frac{(\frac{N}{4}) - cfb)^c}{fw} = 19.5 + \frac{(8.5-6)^5}{4} = 19.5 + \frac{(2.5)^5}{4}$

$= 19.5 + 3.125 = 22.625$

For Q_3, $Q_3 = L + \frac{(\frac{N}{4}) - cfb)^c}{fw}$ = (35-39) in the class.

$= 34.5 + \frac{(3 \times 8.5 - 24)^5}{5} = 34.5 + \frac{(1.5)^5}{5}$

$= 34.5 + 1.5 = 36.0$

3.2.2 Interquartile Range

In the last subsection, you learnt that the quartiles divide the distribution of scores into four equal parts. The inter-quartile range describes the distance between the first quartile Q_1 and the third quartile Q_3. It shows the scores that the included in the middle 50% or half of the scores in the distribution. It is found using the formula $Q_3 - Q_1$. For instance, in the

example 18.2 above $Q_3 = 36.0$ and $Q_1 = 22.625$. The inter-quartile range (IQR) is 36.0 – 22.625 = 13.775.

3.2.3 Quartile Deviation or Semi-interquartile Range

The quartile deviation otherwise called semi-interquartile range is described as half the value of the interquatile range. It is calculated using the formula:

$$\frac{Q_3 - Q_1}{2}$$

For instance, in the example given above, the semi-interquartile range will be given by:

$$\frac{36.0 - 22.625}{2} = \frac{13.735}{2} = 6.87$$

Self Assessment Exercise

Find the semi-interquartile range of the grouped data given below:

S/No	1	2	3	4	5	6	7	8	9	10
Class Interval	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Frequencies	2	2	4	8	10	12	9	7	5	3

3.3 The Percentiles

These are score points along the score line which divide a distribution of scores into hundred subgroups. The subgroups are divided in such a way that they are equal or the same. It is calculated in the same way as the quartiles, but instead of dividing N by 4, you divide by 100. Thus,

$$Pi = L + \frac{(i(\frac{N}{100}) - cfb)^c}{fw}$$

3.3.1 The Deciles

These are score points in a distribution which divide the distribution of scores into Ten equal parts. As in the percentile or quartile the calculation is the same. The formula is:

$$Di = L + \frac{(i(\frac{N}{10}) - cfb)^c}{fw}$$

Note that $Q_1 = P_{25}$, $Q_2 = D_5 = P_{50}$ and $Q_3 = P_{75}$

3.4 The Variance (S^2) and the Standard Deviation (S)

These two measures of variability are directly related. They are the most common, the most reliable estimate of dispersion or spread. They give relative measure to the degree to which each score differs from the mean of the distribution. The standard deviation is the square root of the variance. It is widely used than many other statistical operations.

To calculate the variance and standard deviation, the following steps are applied:

1. calculate the mean of the scores.
2. subtract the mean from each score or class midpoint (if grouped)
3. square each of the differences or deviations - $(X - \overline{X})^2$ or d^2 or x^2
4. Multiply each square deviation by the corresponding frequency, the result is $f(X - \overline{X})^2$ or fd^2 or fx^2.
5. Sum up the result in step (iv) above to obtain $\Sigma f(X - \overline{X})^2$
6. Divide the result of the sum by total number of scores N or the sum of the frequencies i.e. $\Sigma f\frac{(X - \overline{X})^2}{\sum f}$ or $\sqrt{\Sigma f \frac{(X - \overline{X})^2}{\Sigma f}}$. This is the deviation method.

There is also the raw score method otherwise called the machine approach. We shall look at it after the deviation method. Now, let us take some examples.

Example
Find the variance and standard deviation of the following scores:

S/No	X	F	fX	$(X - \overline{X})$	$(X - \overline{X})^2$	f $(X - \overline{X})^2$
1	11	1	11	-4.97	24.70	24.70
2	12	2	24	-3.97	15.76	31.52
3	13	4	52	-2.97	8.82	35.28
4	14	7	98	-1.97	3.88	27.16
5	15	10	150	-0.97	0.94	9.40
6	16	12	192	0.03	0.00	0.00
7	17	11	187	1.03	1.06	11.66
8	18	6	108	2.03	4.12	24.72
9	19	4	76	3.03	9.18	36.72
10	20	3	60	4.03	16.24	48.72
		60	**958**			**249.88**

Steps: (i) Find the mean = $\frac{\Sigma fx}{\Sigma f} = \frac{958}{60} = 15.97$

(ii) Find the deviation = $(X - \overline{X})$

(iii) Find the square deviations.

(iv) Multiply the square deviations by the frequency to obtain f $(X - \overline{X})^2$

(v) Find $\Sigma f(X - \overline{X})^2 = 249.88$

(vi) Divide by Σf or N to get variance.

(vii) Find the square root

$$\frac{249.88}{60} = 4.646667$$

$$S^2 = 4.16$$

$$\therefore \sqrt{4.16} = 2.04$$

You can also use the raw score approach. Let us use the raw score approach for the same set of scores in Example.

S/N	X	f	Fx	X^2	Fx^2
1	11	1	11	121	121
2	12	2	24	144	288
3	13	4	52	169	676
4	14	7	98	196	1372
5	15	10	150	225	2250
6	16	12	192	256	3072
7	17	11	187	289	3179
8	18	6	108	324	1944
9	19	4	76	361	1444
10	20	3	60	400	1200
		60	**958**		**15546**

Step:

(i) Complete the composite table as shown.

(ii) For variance (S^2) use the formula = $\frac{(\Sigma f)\Sigma fx^2 - (\Sigma fx)^2}{(\Sigma f)^2}$ or

$\frac{N\Sigma fx^2 (\Sigma fx)^2}{N^2}$

Substituting, we have: $S^2 = \frac{60 \times 15546 - 958^2}{3600}$ or $\frac{14996}{3600}$

$= 4.165$

For standard deviation, S. Find the square root of the variance i.e. $\sqrt{4.165} = 2.04$

Self Assessment Exercise
Find the variance and standard deviation of the following:

S/No	1	2	3	4	5	6	7	8	9	10
Class interval	3	4	5	6	7	8	9	10	11	12
Frequencies	2	4	8	9	10	7	5	3	2	1

Sometimes, you may be given grouped scores. The same method is used. The only different is that you have to find and use the midpoints of the groups or class intervals as your score X.

4.0 CONCLUSION

In this unit, you have gone through the other measures which are used to determine the extent of spread or variability in a given set of scores. They represent a measure of homogeneity within a group of scores. The standard deviation is applied in most other statistical tests.

5.0 SUMMARY

You have seen that the range is a measure of the distance between the highest and the lowest scores in a distribution. The quartiles are score points which divide the distribution into four equal parts. We have Q_1, Q_2 and Q_3. The percentiles divide the distribution into hundred equal parts,. The deciles divide the distribution into ten equal parts. You have also gone through variance and standard deviation which are the most reliable estimate of dispersion or spread. The standard deviation is the square root of the variance.

In the next unit, we shall be looking at the measures of association.

Tutor Marked Assignment

In the data below, find:
(i) The semi-interquartile range, and
(ii) The standard deviation

S/N	1	2	3	4	5	6	7	8	9	10
Class Interval	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Frequencies	1	2	4	5	10	8	6	4	3	2

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UNIT 4 MEASURES OF ASSOCIATION/CORRELATION

CONTENT

1.0 INTRODUCTION

In the previous units, we have focused on sample scores from one variable or distribution of scores from one variable. In this unit, you will learn about matched or paired sets of scores. Specifically, measures of association show the degree of relationship between two or more variables.

We shall be looking at some of these measures or the statistics for describing the extent of correlation or 'going together' of some attributes or characteristics possessed by a sample of individuals. This degree of relationship between the attributes or variables is expressed as a coefficient of correlation.

The result of this unit will teach you the most common types of correlation which are Pearson .Product Moment and Spearman Rank Order.

2.0 OBJECTIVES

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

- define correlation;
- illustrate the scatter-grams of various correlations;

- calculate the Pearson *r;*
- calculate the Spearman *rho*.

3.0 MAIN CONTENT

3.1 The Concept of Correlation

Correlation refers to the extent or degree of relationship between two variables. The index showing the degree of such relationship between the two variables is called correlation-coefficient.The value obtained from correlation will help you as a researcher to know whether variations in one set of scores lead to variations in another set of scores. It will also help you to know the extent to which this variation takes place.

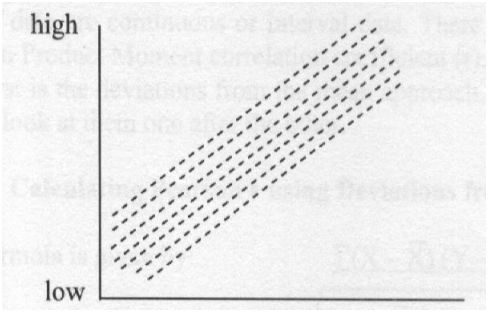
Correlation values ranges from -1 to +1. It means that a correlation coefficient of-1 indicates a perfect negative relationship; while +1 shows perfect positive relationship and 0 correlation coefficient implies no relationship at all. Many types of correlation coefficients exist. You can use any type, but this will depend on the following:

(i) the type of measurement scale in which the variables are;
(ii) the nature of the distribution (i.e. continuous or discrete);
(iii) the characteristics of the distribution scores,

3.2 Scatter-Grams of Various Correlations

A scatter-gram is a shortened form of scatter diagram. It shows the plots on the Cartesian coordinate plane of two sets of scores of individuals of a sample with respect to two attributes which are usually denoted by X and Y.

i. Positive Relationship: This suggests that individuals having high scores in one variable also have high scores in the other variable. It also implies that those individuals who have low scores in one variable also have low scores in the other variables.



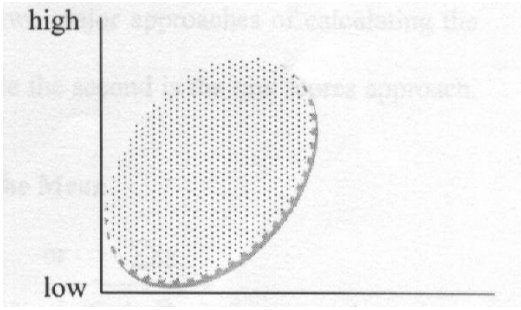
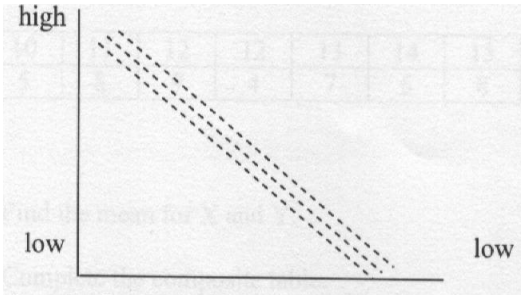


Fig.4.1

(a) r = Perfect Positive Relationship (b) r = Moderate Positive Relationship

ii. Negative Relationship: As you can see, this is the opposite of positive relationship. It suggests that individuals scoring high on one variable score low on another variable. It also implies that those who score low on one variable score high on the other variable.



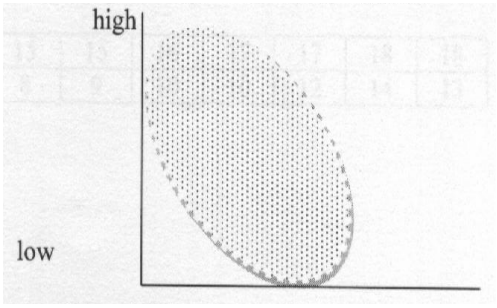


Fig.4.2

(c) r = Perfect Negative Relationship (d) r = Moderate Negative Relationship

iii. Zero Relationship: This suggests the absence of any relationship. There is no relationship between scores on the two variables.

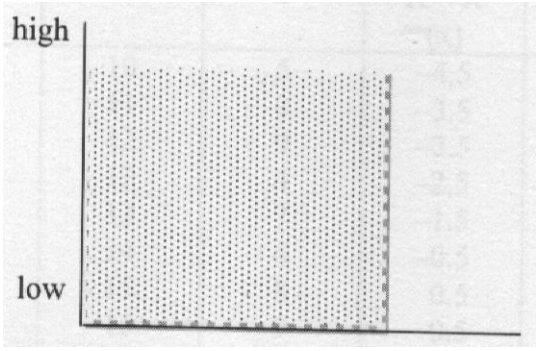


Fig.4.3
(e) r = No Relationship

3.3 Pearson Product Moment Correlation Coefficient (r)

This type of correlation coefficient, named after the man who developed it, is used when the two sets of data are continuous or interval data. There are two major approaches of calculating the Pearson Product Moment correlation coefficient (r).

The first is the deviations from the mean approach, while the second is the raw scores approach. Let us look at them one after the other.

3.3.1 Calculating Pearson r using Deviations from the Mean

The formula is given by: $\frac{\sum(X-\overline{X})(Y-\overline{Y})}{\sqrt{\sum(X-\overline{X})^2\sum(Y-\overline{Y})^2}}$ or $\frac{\sum xy}{\sqrt{(\sum X^2)(\sum Y^2)}}$ y

where $x = X-\overline{X}$, $y = Y-\overline{Y}$

Example 1:
Using the data below, calculate the Pearson r.

X	10	11	12	12	13	14	15	15	16	17	17	18	18
Y	5	8	9	4	7	6	8	9	10	10	12	14	13

Step:

(i) Find the mean for X and Y.
(ii) Complete the composite table.
(iii) If $\Sigma xy = 80.90$, $\Sigma x^2 = 87.25$, $\Sigma y^2 = 107.72$, Then $\frac{\sum xy}{\sqrt{\sum x^2 y^2}} =$ r

	X	Y	X-X (x)	Y-Y (y)	xy	X^2	y^2
1	10	5	^.5	-3.8	17.10	20.25	14.44
2	11	8	-3.5	-0.8	2.80	12.25	0.64
3	12	9	-2.5	0.2	-0.50	6.25	0.04

4	12	4	-2.5	-^.8	12.00	6.25	23,04
5	13	7	-1.5	-1.8	2.70	2.25	3.24
6	14	6	-0.5	-2.8	1.40	0.25	7.84
7	15	8	0.5	-0.8	-0.40	0.25	0.64
8	15	9	0.5	0.2	0.10	0.25	0.04
9	16	10	1.5	1.2	1.80	2.25	1.44
10	17	10	2/5	1.2	3.00	6,25	1.44
11	17	12	2.5	3.2	8.00	6.25	10.24
12	18	14	3.5	5.2	18.20	12.25	27.04
13	18	13	35	4.2	14.70	12.25	17.64
	188 **14.5**	**115** **8.8**			**80.90**	**87.25**	**107.7** **2**

$$r = \frac{80.90}{\sqrt{87.95 \times 107.72}} = \frac{80.90}{\sqrt{9,398.57}} = \frac{80.90}{96.945}$$

$r = 0.83$

3.3.2 Calculating Pearson r using the Raw Score Method

The formula is given by $r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - \left(\sum X^2\right) - \left(N\sum Y^2 - \left(\sum Y\right)^2\right)}}$

where $x = X - \overline{X}$, $y = Y - \overline{Y}$

Example 2:

Let us use the same data in example 19.1.

X	10	11	12	12	13	14	15	15	16	17	17	18	18
Y	5	8	9	4	7	6	8	9	10	10	12	14	13

Steps:

i. Complete the composite table.

ii. If N = 13, $\Sigma X = 188$, $\Sigma Y = 115$, $\Sigma XY = 1744$, $\Sigma X^2 = 2806$ and $\Sigma Y^2 = 1125$, then:

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - \left(\sum X^2\right) - \left(N\sum Y^2 - \left(\sum Y\right)^2\right)}}$$

S/N	X	Y	XY	X^2	Y^2
1	10	5	50	100	25
2	11	8	88	121	64
3	12	9	108	144	81
4	12	4	48	144	16
5	13	7	91	169	49
6	14	6	84	196	36

7	15	8	120	225	64
8	15	9	135	225	81
9	16	10	160	256	100
10	17	10	170	289	100
11	17	12	204	289	144
12	18	14	252	324	196
13	18	13	234	324	169
Σ	**188**	**115**	**1744**	**2806**	**1125**
	14.5	**8.8**			

$$r = \frac{13\times1744-188\times115}{\sqrt{13\times2806-188^2\times13\times1125-115^2}}$$

$$= \frac{22672-21620}{\sqrt{36478-35344\times14625-13225}}$$

$$= \frac{1052}{\sqrt{1134\times1400}}$$

$$= \frac{1052}{1260} = 0.83$$

You can see that the two approaches give the same result. This is because the formula of the raw scores method is derivable from the formula of the deviations from the mean method. You will have to note that when the scores are large and the means of X and Y are whole numbers, the deviations from the mean method becomes simper to handle. But when the means of X and Y are not whole numbers the raw score method is preferred.

SELF-ASSESSMENT EXERCISE

Use any method to calculate the Pearson r of the data:

S/N	1	2	3	4	5	6	7	8	9	10
X	51	44	70	32	65	67	19	71	45	80
Y	49	41	45	31	50	61	11	64	21	75

3.4 Spearman Rank Order Correlation Coefficient - *rho*

This correlation coefficient was developed independently by Spearman and Brown. This is why it is sometimes referred to as Spearman-Brown Rank Order Correlation Coefficient. It is more popularly known as Spearman rho, because Spearman was the first to publish it. It is an approximation of the Pearson r. It is used when the scores in each variable arc ranked in the same direction, with respect to magnitude.

So, in the use of Spearman rho, ranking is emphasized. It must be done and correctly too.

3.4.1 Calculation of Spearman Rank Order Correlation

The formula is given by: rho = $1-\frac{6\sum D^2}{N(N^2-1)}$

Example 3:
Calculate the rho of the data presented below:

S/N	1	2	3	4	5	6	7	8	9	10
X	51	44	70	32	65	67	19	71	45	80
Y	49	41	45	31	50	61	11	64	21	15

S/N	X	'Y	RX	RY	D	D^2
1	51	49	6	5	1	1
2	44	41	8	7	1	1
3	70	45	3	6	-3	9
4	32	31	9	8	1	1
5	65	50	5	4	1	1
6	67	61	4	3	1	1
7	19	11	10	10	0	0
8	71	64	2	2	0	0
9	45	21	7	9	-2	4
10	80	75	1	1	0	0
Σ						**10**

Steps:

i. Complete the composite table by getting the ranks and the differences between the ranks.

ii. Apply the formula: rho = $1-\frac{6\sum D^2}{N(N^2-1)}$

rho = $1-\frac{6\times 18}{10(10^2-1)}$ = $1-\frac{108}{10\times 99}$ = $1-\frac{108}{990}$

= 1 – 0.109 = 0.891

3.5 Point Biserial Correlation Coefficient - *rpbi*

You have worked through the Pearson r and Spearman rho. Let us close this unit with the point biserial correlation coefficient which is used when one variable has dichotomized values. .Typical examples of variables which can use rpbi are scores and sex.

Example 4:

S/N	1	2	3	4	5	6	7	8	9	10	11	12
X	10	15	11	13	12	18	20	14	16	17	09	07
Y	G	B	G	B	G	G	B	G	B	B	B	B

The formula for this is given by: rpbi $= \frac{\overline{X}p - \overline{X}q}{St}\sqrt{pq} = \frac{\overline{X}p - \overline{X}t}{St}\sqrt{p/q}$

where $\overline{X}p$ =mean score of the continuous variable of the subgroup that belongs to the natural dichotomy p.

$\overline{X}q$ = mean score of the continuous variable of the subgroup that belongs to the natural dichotomy q.

st = standard deviation of the total scores for the whole group on the continuous variable.

p = proportion of the number of members in subgroup p.

q = proportion of the number of members in subgroup q.

Now, let us look at the steps you can follow:

i. Find $\overline{X}p$ = mean for the proportion of boys and the group.

= $\frac{15+13+20+16+17+09+07}{7} = \frac{97}{7} = 13.86$

ii. Find $\overline{X}q$ = mean for the proportion of girls in the group.

= $\frac{10+11+12+18+14}{5} = \frac{65}{5} = 13.0$

iii. Find p= 7/12 = 0.58

iv. Find q = 5/12 = 0.42.

v. Find St.

S/N	X	X-X	$(X - \overline{X})^2$
1	10	-3.5	12.25
2	15	1.5	2:25
3	11	-2.5	6.25
4	13	-0.5	0.25
5	12	-1.5	2.25
6	18	4.5	20.25
7	20	6.5	42.25
8	14	0.5	0.25
9	16	2.5	6.25
10	17	3.5	12.25
11	09	-4.5	20.25
12	07	-6.5	42.25
Σx	**162**	**13.5**	**167.00**

$$St = r \sqrt{\frac{\sum (X - \overline{X})^2}{n}} = \sqrt{\frac{167}{12}} = \sqrt{13.92}$$

$$= 3.73$$

$$\therefore rpbi = \frac{\overline{X}p - \overline{X}q}{St} \sqrt{pq} = \frac{13.86 - 13.0q}{3.73} \sqrt{0.58 \times 0.42}$$

$$= 0.2305563 \times 0.493558$$

$$= 0.1137963 = 0.11$$

SELF-ASSESSMENT EXERCISE

Find the *rpbi* of the following data:

S/N	i	2	3	4	5	6	7	8	9	10	11	12	13
X	60	40	55	20	70	35	48	15	30	57	65	25	30
Y	G	B	B	G	B	G	B	G	B	G	B	G	G

4.0 CONCLUSION

A very good number of research studies tend to determine the nature and scope of relationships which exist between two or more variables being investigated. In this unit, you have seen that the degree of relationship which exists between variables is referred to as correlation. You have also noted that the statistical index of measuring the relationship is called correlation coefficient.

This correlation coefficient presents a picture of how a change in one variable results in a change in the corresponding correlated variable. The result of the correlation tests can be used for predictive purposes. But they cannot be used for establishing a cause-effect relationship between two variables.

5.0 SUMMARY

In this unit, you have learnt that correlation is the extent or degree of relationship between two variables while the index showing the degree of such relationship between the two variables is i called correlation coefficient Correlation values range from-1 to+1. Scatter-grams of different [types of relationships were shown. Pearson Product Moment Correlation Coefficient otherwise called Pearson r was also discussed with the two methods for the computation. These are the deviation and the raw score methods. The methods for calculating the Spearman rho and the Point Biserial Correlation *(rpbi)* were discussed in detail. The next unit will take us to the test of hypotheses to complete the module.

6.0 TUTOR-MARKED ASSIGNMENT

i. Using any convenient correlation method, calculate the correlation coefficient of the data given below:

5/N	1	2	3	4	5	6	7	8	9	10	11	12
X	31	24	50	12	45	47	09	51	25	60	15	10
Y	29	21	25	11	30	41	01	44	11	55	05	03

ii. What is the interpretation of the correlation results?

7.0 REFERENCES/FURTHER READING

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UNIT 5 HYPOTHESES

CONTENTS

1.0 INTRODUCTION

Hypothesis is can be considered as the major instrument in research. The formulation of a very good hypothesis goes hand in hand with the selection of a good research problem. Hypothesis is a tentative hunch, which explains the situation under study. In other words, the researcher designs the study to prove or disprove it. Every researcher looks for a working or positive hypothesis. This is because it is very difficult, laborious and time consuming to make adequate discriminations in the complex interplay of facts without hypothesis. A hypothesis gives definite point and direction to the study. It prevents blind search and indiscriminate collection of data and helps to delimit the field of inquiry. Now let us look at the concept of hypotheses in details.

2.0 OBJECTIVES

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

- explain the concept of hypothesis
- discuss the importance of hypothesis
- describe the sources of hypothesis
- explain the types of hypothesis
- explain the characteristics of a good hypothesis
- formulate the types of hypothesis.

3.0 MAIN CONTENT

3.1 The Concept of Hypothesis

Hypothesis whose plural is hypotheses, is derived from a Greek word called 'hypotithenai' which means 'to put under' or 'to suppose.' When a hypothesis is put forward as a scientific hypothesis, a scientific method is required to test it. Etymologically, hypothesis is made up of two words, "hypo" (less than) and "thesis", which means less than or less certain than a thesis. It can be regarded as the presumptive statement of a proposition or a reasonable guess, which is based on available evidence, and which you as a researcher seek to prove by having the study. Lundberge described hypothesis as a tentative generalisation, the validity of which remains to be tested. In a layman's view, hypothesis may be described as a hunch, guess, imaginative idea, which becomes the basis for action or investigation.

In their own description, Goode and Hatt see hypothesis as a proposition which can be put to test to determine its validity. Let us look at hypothesis as a statement temporarily accepted as true in the light of what is known about a phenomenon, at a time, and it is employed as a basis for action in the search of new truth. You can now see that hypothesis is a tentative assumption drawn from knowledge and theory and it is used as a guide in the investigation of other facts and theories that are yet unknown.

It can also be taken as a guess, a supposition or a tentative conclusion as to the existence of some facts, conditions or relationships relative to some phenomenon. it serves to explain such facts as already known to exist in a given area of research and to guide the search for new truth.
Hypothesis shows a reflection of the researcher's guess as to the probable outcome of the experiments or investigation You can take a hypothesis to mean a shrewd and intelligent guess, a supposition, inference, hunch, provisional statement or tentative generalisation of the existence of some facts, conditions or relationships relative to some phenomenon which serves to explain already known facts in a given area of research and to guide the study to arrive at new truth on the basis of empirical evidence. It is then put to test for its tenability and for determining its validity.

Most times, we regard a research hypothesis as a predictive statement, capable of being tested by scientific methods, which relates an independent variable to some dependent variable. For instance we can say that learners who receive facilitation on line do better than those who do not have on-line facilitation. "There is a positive relationship

between academic achievement scores and scores on completion of self study material in Open and Distance Learning ”

3.2 Importance of Hypothesis

Hypothesis is recommended for all major studies to explain observed facts, conditions or behaviour and to serve as a guide in the research process. The importance of hypotheses may be summarised as follows.

1. It facilitates the extension of knowledge in an area. It provides tentative explanations of facts and phenomena, and can be tested and validated. It sensitises the investigator to certain aspects of situations which are relevant from the standpoint of the problem in hand.

2. It provides you with rational statements, consisting of elements expressed in a logical order of relationships which seek to describe or to explain conditions or events, that have not yet been confirmed by facts. It enables you to relate logically known facts to intelligent guesses about unknown conditions. It is a guide to the thinking process and the process of discovery.

3 It provides direction to the research. It defines what is relevant and what is irrelevant. It tells you such specific needs you need to do and find out in your study. Thus it prevents the review of irrelevant literature and the collection of useless or excess data. It also provides a basis for selecting the sample and the research procedures to be used in the study. The statistical techniques needed in the analysis of data, and the relationships between the variables to be tested, are also implied by the hypotheses. Furthermore, the hypotheses help the researcher to delimit his study in scope so that it does not become broad or unwieldy.

4. It provides the basis for reporting the conclusions of the study. It serves as a framework for drawing conclusions. You will find it very convenient to test each hypothesis separately and state the conclusions that are relevant to each. On the basis of these conclusions, you can make the research report interesting and meaningful to the reader. It provides the outline for setting conclusions in a meaningful way.

3.3 Sources of Research Hypothesis

Research hypotheses may be derived directly from the statement of the problem; they may be based on the research literature, or in some cases, such as in ethnographic research, they may be generated from data collection and analysis. The various sources of hypotheses may be

- Review of similar studies in the area or of the studies on similar problems;
- Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;
- Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution.
- Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.
- Intuition is often considered a reasonable source of research hypotheses -- especially when it is the intuition of a well-known researcher or theoretician who "knows what is known"
- Rational Induction is often used to form "new hypotheses" by logically combining the empirical findings from separate areas of research
- Prior empirical research findings are perhaps the most common source of new research hypotheses, especially when carefully combined using rational induction
- Thus hypothesis are formulated as a result of prior thinking about the subject, examination of the available data and material including related studies and the council of experts.

3.4 Types of Hypothesis

A research hypothesis is a predictive statement that relates an independent variable to a dependent variable. It must contain, at least, one independent and one dependent variable. It must be stated in a testable form for its proper evaluation. You already noted, that it is important to indicate a relationship between the variables in clear, concise, and understandable language. Research hypotheses are classified as being directional or non-directional.

3.4.1 Directional Hypothesis

All hypotheses which stipulate the direction of the expected differences or relationships are known as directional hypotheses. For example, the research hypothesis: "There is a significant positive relationship between learners' scores in English and their score in English

Literature" is a directional research hypothesis. This hypothesis shows that learners who score highly in English also score high in English Literature, and therefore stipulating the direction of the relationship.

3.4.2 Non-directional Hypothesis

This is a research hypothesis which does not specify the direction of expected differences or relationships. For instance, the hypotheses: "There will be significant difference in the achievement scores of male and female learners in Statistical Methods. You can see that this hypothesis stipulates that there will be a difference, but the direction of the difference is not specified. A research hypothesis can also take statistical form, declarative form, the null form, or the question form.

3.4.3 Statistical Hypothesis

A statistical hypothesis is given in statistical terms and used to test whether the data collected support or refute the research hypothesis. Technically, it is used in the context of inferential statistics as a statement about one or more parameters that are measures of the populations under study. Most of the times, they are given in quantitative terms. For instance: "The mean achievement score of learners taught through e- facilitation is equal to the mean achievement score of the learners taught through physical facilitation." We can therefore say that statistical hypotheses are, concerned with populations under study. We use inferential statistics, to draw conclusions about population values even though we have access to only a sample of participants. We normally use inferential statistics by translating the research hypothesis into a testable form, which is called the null hypothesis. An alternative or declarative hypothesis indicates the situation where the null hypothesis is not true. The stated hypothesis will differ depending on whether or not it is a directional research hypothesis.

3.4.4 Declarative Hypothesis

This is used when the researcher makes a positive statement about the outcome of the study. For instance, the hypothesis: "The academic achievement of male students is significantly higher than that of the female students in Physics," is a declarative hypothesis. In this case, you as a researcher make a prediction based on your theoretical formulations of what should happen if the explanations of the behaviour you have given in your theory are correct.

3.4.5 Null Hypothesis

Here you make a statement that no relationship exists. For instance, "There is no significant difference between the academic achievement of open and distance education students and that of conventional education students," this is an example of null hypothesis. Since null hypotheses can be tested statistically, they are also regarded as statistical hypotheses. They can be called the testing hypotheses when declarative hypotheses are tested statistically by converting them into null form. It states that even where it seems to true, it is due to mere chance. It is left for you to reject the null hypothesis by showing that the outcome mentioned in the declarative hypothesis occurs and that it cannot be easily dismissed as having occurred by chance.

3.4.6 Question Form Hypothesis

In this case, a question is asked as to what the outcome will be instead of stating what outcome is expected. For instance, if you are interested in finding out whether the use of computer in learning has any relationship to academic performance of students in ODL, then, the declarative form of the hypothesis should be: "The use of computer in learning will increase the academic performance of students in ODL".

The null form would be: " The use of computer in learning will have no effect on the academic performance of students in ODL.' This shows that no relationship exists between the use of computer in learning and academic performance of ODL students.

The question form can be stated as follows: "Will the use of computer in learning increase the academic performance of students in ODL?

3.5 Characteristics of a Good Hypothesis

A good hypothesis must have the following characteristics:

i) It should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
ii) ii) It should be capable of being tested. A hypothesis "is testable if other deductions can be made from it which, in turn, can be confirmed or disproved by observation."
iii) iii) It should state relationship between variables, if it happens to be a relational hypothesis.
iv) iv) It should be limited in scope and must be specific. You must remember that narrower hypotheses are generally more testable, you should therefore develop such hypotheses.

v) v) It should be stated as far as possible in most simple terms so as to be easily understandable by all concerned. But you have to remember that simplicity of hypothesis has nothing to do with its significance.

vi) vi) It should be consistent with known facts i.e. it must be consistent with a substantial body of established facts.

vii) It should be amenable to testing within a reasonable time. You should not select a problem which involves hypotheses that are not agreeable to testing within a reasonable and specified time.

viii) It must explain the facts that gave rise to the need for explanation.

This means that a hypothesis must actually explain what it claims to explain, it should have empirical reference.

4.0 CONCLUSION

As earlier mentioned, note that every researcher looks for a working or positive hypothesis. This is because it is very difficult, laborious and time consuming to make adequate discriminations in the complex interplay of facts without hypothesis. A hypothesis gives definite point and direction to the study. It prevents blind search and indiscriminate collection of data and helps to delimit the field of inquiry.

5.0 SUMMARY

In this unit, you learnt that hypothesis can be considered as the major instrument in research. The formulation of a very good hypothesis goes hand in hand with the selection of a good research problem. Hypothesis is a tentative hunch, which explains the situation under study. In other words, the researcher designs the study to prove or disprove it. Every researcher looks for a working or positive hypothesis.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the concept of hypothesis
2. Discuss the importance of hypothesis
3. Describe the sources of hypothesis
4. Explain the types of hypothesis
5. Explain the characteristics of a good hypothesis.

7.0 REFERENCE/FURTHER READING

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UNIT 7 TESTING OF HYPOTHESIS

1.0 INTRODUCTION

In Module one, you were introduced to the types of hypotheses. In this unit, you will learn how to test the hypotheses using some of the statistical tests. The purpose of testing a hypothesis is to determine the probability that it is supported by facts. You may test a hypothesis by applying it to already known facts or taking it as a new appeal to experience. This same mental technique to problem-solving is also employed by science and philosophy.

Hypotheses are used as indicators of the realistic answers which researchers have to their stated problems or questions in research. So when hypotheses are tested, the results lead to establishment of new facts or confirmation of old ones. If a hypothesis is successfully verified or tested and confirmed to be true, it is then used to support a theory.

In other words, theories are developed, tested and confirmed in research through the process of hypothesis testing. This leads to the generation or advancement of knowledge. In this unit, you are going to be exposed to the rudiments of the processes involved in testing hypotheses,

2.0 OBJECTIVES

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

- explain the alpha level or level of confidence and degree of freedom;
- discuss the two types of errors in hypothesis testing;
- illustrate how to use the t-test to test a given null hypothesis;
- describe how to use the relationship between correlation coefficient and t-test in hypothesis testing;
- discuss how to use analysis of variance to test hypothesis;
- outline how to use chi-square to test hypothesis;
- explain the meaning of one-tailed and two-tailed tests.

3.0 MAIN CONTENT

3.1 Selection of the Level of Significance or Alpha Level

In proposing your hypothesis, you must include a confidence limit, otherwise called alpha level (α) or significance level. In most researches in education, two alpha levels are used. These are 5% (0.05) and 1% (0.01). If you choose 5% in a particular study, the implication is that if your study is replicated 100 times, the same outcome will occur 95 out of 100, and 5 out of 100 may vary due to chance. If it is 1% (0.01) level of significance, it means that if your study is replicated 100 times, you are sure 99 out of 100 will be correct while 1 out of 100 may vary due to chance factors. This is a more rigorous confidence level.

At this point, you need to note that when you test a hypothesis, you are only dealing with probability of something being true or false. Hypothesis testing helps you to make predictions ' and not to establish causation. It does not provide absolute proof. In other words, a hypothesis cannot be proved absolutely true or false.

3.2 Degrees of Freedom

This is the number of observations which are free to vary when certain restrictions have been placed on the data being considered, Take for instance, in your class, you ask your students to provide any four numbers which would be added to 4 to add up to 24. In this case, it is fixed, other numbers can vary. But no matter how they vary, 4 must be added to sum up to 24. Therefore, the degree of freedom here is N - 1, where N is the total number of choices while 1 is the fixed variable. As we go on, you will see the modal for getting the degrees of freedom for different tests.

3.3 Type I and Type II Errors

When you embark on a research study which involves the testing of hypothesis, the level of significance and the degree of freedom will enable you to take a decision about whether to accept or not to accept (reject) the hypothesis. If the null hypothesis which you have proposed is true and you accept it because your evidence supports it, then you are quite in order. It is correct. But if the null hypothesis is true based on the available evidence and you reject it, it is not correct. It is an error. Thus, the rejection of a true null hypothesis when it should have been accepted is known as Type I error.

On the other hand, if the null hypothesis is false and you accept it, instead of rejecting it, you are also not correct. In other words, the acceptance of a false null hypothesis when it should have been rejected is referred to as Type II error.

You have to note that as you try to minimize type I error by becoming too rigorous, may be you reduce the significance level from 5% to 1%, you stand the chance of making type II error by increasing the level of significance from 1% to 5%.

3.4 Two-tailed and One-tailed Tests

When hypothesis is stated in such a way that it does not indicate a direction of difference, but agrees that a difference exists, we apply a two-tailed test of significance. Most of the null hypotheses are two-tailed because they do not indicate the direction of difference. They merely state that there is no significant difference between A and B. For instance, there is no significance difference in academic performance between those who went to Federal Government Colleges and those who went to State Schools,

When hypothesis is stated to indicate the direction of difference, it is called a one-tailed test. For example, people who live in high altitude areas perform better in long distance races. People who have stout bodies do better in short-put. Expensive cars are better in performance etc.

3.5 The T-test

The t-test otherwise called the student's t-test is an inferential technique. It was developed by William Gosset in 1908. There are various t-test techniques used for various tests of hypothesis concerning the following:

i. difference between population and sample means;
ii. difference between two independent samples' means;
iii. difference between matched samples' means;
iv. the significance of Pearson r;
v. difference between correlated coefficients;
vi, difference between variances that are correlated.

We are not going to treat all these in this course, hut during your master's degree programme, you will have all or most of them. For this unit, we shall take only three methods, Before we go into that, you will have to note that there are conditions for the use of t-tests. These are:

i. there must be two groups to be compared;
ii. the population from which the samples are drawn must be normally distributed;
iii. the population variances are homogenous;
iv. the samples are independent or randomly drawn from the population;
v. the variables have continuous values;
vi, suitable for both large and small samples (but not less than ten).
Note that any sample size less than 30 is regarded as small, but when the sample size is more than 30, it is regarded as large. The procedure for carrying out z-test is the same to that oft-test. While z-test is specifically used for large samples, t-test can be used for both small and large samples. When t-test is used for large samples, it approximates to z-test.

3.5.1 Difference between Population and Sample Means

When you want to compare a population and sample means, you will use this mode:

$$t = \frac{\overline{X} - \mu}{S/\sqrt{n-1}}$$ where $\overline{X}$ = sample mean

μ = population mean
S = standard deviation
n = number.
For instance, you are given that the mean achievement score of all SS.I students in Ihitte/Uboma, in an English standardized test is 55%. A

teacher conducted a study to verify this claim. He used 25 SS.I students in that locality. He drilled them on the different aspects of English syllabus for SS.I, for about eight weeks. At the end, the teacher administered the English test on the 25 students. His results are 59.85 as mean and 8.50 as standard deviation.

The first step is to propose a hypothesis (Ho). You can say the sample mean of 59.85 is not significantly greater than the population mean of 55, at an a level of 0.05 or you can say that there is no significant difference between the sample mean of 59.85 and population mean of 55.

$t = \frac{\overline{X} - \mu}{S/\sqrt{n-1}}$ where $\overline{X} = 59.85$, $\mu = 55$, $S = 8.50$ and $n = 25$

$\therefore \quad t = \frac{59.85 - 55}{\frac{8.5}{\sqrt{25-1}}} = \frac{4.85}{8.50} \times \sqrt{24} = 0.57 \text{ x } 4.899 =$

2.795

At this point, you have to take a decision. This will be based on the comparison of the calculated value oft-test and the value oft-test on the table or the critical region.

Now that $tc_{al} = 2.795$, df - 25 - 1 = 24, alpha level - 0.05

$\therefore \quad t_{tab}$at (25 : 0.05) = 2.060.

For decision rule, if calculated value is greater than the value in the table or critical value, Reject the null hypothesis. But, if the calculated value is less than the value on the table, Accept ho.

From this result, t_{cal} is greater than the t_{tab} i.e. 2.795 > 2.060. We therefore reject that there is no significant difference between the population mean and the sample, mean. It implies that there is a significant difference between the two means.

SELF-ASSESSMENT EXERCISE

What do you understand by the following?

(a) P < 0.05
(b) degree of freedom
(c) Type I and Type II errors
(d) Two tailed and one tailed test.

3.5.2 Difference between Two Independent Samples' Means

In section 3.5.1, you learnt how to find the t-test of significance when the population mean and the sample mean are given. Most of the times, you will be confronted with a situation where two samples are randomly and independently drawn from a normal population. If the variances of the samples as estimates of the population variance do not differ significantly or are homogenous, we can then say that they have a t-distribution, This is particularly when the samples' sizes are not large. Remember that a large sample size is from 30 and above. The t-statistics which you can use in this case is as follows:

$$t = \frac{\overline{X} - \overline{X}}{\sqrt{\frac{\left[(n_1 - 1)S_1^{\,2} + (n_2 - 1)S_2^{\,2}\right](n_1 + n_2)}{(n_1 + n_2 - 2)n_1 \times n_2}}}$$

where $S1 = \sqrt{\frac{\sum(X_1 - \overline{X}_2)}{n_1 - 1}}$

Example 2:

A teacher wanted to compare the academic performance of two sets of students in his school with a view to finding out whether their mean performances are significantly different. He collected samples of the two sets. His results are shown in the table below:

Set	Mean Performance	Standard deviation	No. of Samples
2005	50%	14.50	80
2006	58%	12.00	75

Solution:

i. Propose a null hypothesis H_0: There is no significant difference between the mean performances of the students from the two sets.

ii. $$t = \frac{\overline{X} - \overline{X}}{\sqrt{\frac{\left[(n_1 - 1)S_1^{\,2} + (n_2 - 1)S_2^{\,2}\right](n_1 + n_2)}{(n_1 + n_2 - 2)n_1 \times n_2}}}$$

$$t = \frac{58 - 50}{\sqrt{\frac{\left[(75 - 1)12^2 + (80 - 1)(14.5^2)\right](75 + 80)}{(75 + 80 - 2)75 \times 80}}}$$

$$= \frac{8}{\sqrt{\frac{\left[(74)144 + (79)210.25\right](155)}{153 \times 6000}}}$$

$$= \frac{8}{\sqrt{\frac{(10656+16609.75)155}{918000}}}$$

$$= \frac{8}{\sqrt{\frac{27265.75\times155}{918000}}}$$

$$= \frac{8}{\sqrt{\frac{4226191.3}{918000}}}$$

$$= \frac{8}{\sqrt{4.6036942}} \qquad = \frac{8}{2.1456221}$$

$$= 3.7285224 \qquad = 3.73$$

iii. Decision:

$t_{cal} = 3.73$, t_{tab} at $(75 + 80 – 2 : 0.05/2) = t_{tab}$ at $153 : 0.05$
$t_{cal} = 3.73$. $t(153:0.025) = 1.96$

Since t_{cal} is greater than t_{tab}, we reject H_0. It means that there is a significant difference between the mean performances of the two sets of students.

SELF-ASSESSMENT EXERCISE

The result of a researcher's study, to find out if there is a significant difference between the performances of males and females in his class is given below:

Gender	Mean Performance	Standard deviation	No. of Samples
Males	65%	11.50	45
Females	58%	14.20	40

Are the gender-wise performances significantly different?

3.5.3 Difference between Two-Matched Sample Means

Most of the times, researchers are faced with some situations where they have to compare the performances of a set of students in two different subjects or related subjects, reaction times, tolerance levels to two types of drugs or situations etc. When this happens, the pairs of samples are not independent. The samples can be constituted through randomization. Therefore, if the samples are matched, we assume that there is no

difference between the two sets of scores or variables. It implies that $\overline{X}_1 - \overline{X}_2$. So $\overline{X}_1 - \overline{X}_2 = d$, and $\frac{\sum d}{n} = \bar{d} = 0$.

The t-statistic is therefore given by the formula: $t = \frac{\bar{d}}{S/\sqrt{n-1}}$

where $\bar{d} = \frac{\sum d}{n}$, S = standard deviation of the ds.

Example 3:

A set of students took tests in both Mathematics and Statistics. Their results are as follows:

S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mathematics	50	65	70	35	44	52	67	72	48	38	59	65	62	40	54	64	70	55
Statistics	48	60	74	30	40	50 -	69	70	50	42	60	70	60	29	52	61	70	53

Are the results significantly different?

i. Complete the table by getting d = difference (linear) between Mathematics and Statistics.

S/N	**Mathematics**	**Statistics**	**D**	**d^2**
1	50	48	2	4
2	65	60	5	25
3	70	74	-4	16
4	35	30	5	25
5	44	40	4	16
6	52	50	2	4
7	67	69	-2	4
8	72	70	2	4
9	48	50	-2	4
10	38	42	-4	16
11	59	60	-1	1
12	65	70	-5	25
13	62	60	2	4
14	40	29	11	121
15	54	52	2	4
16	64	61	3	9
17	70	70	0	0
18	55	53	2	4
Σ			**22**	**286**

ii. Find $\bar{d}$ = mean of d = $\frac{\sum d}{n} = \frac{22}{18}$ = 122.

iii. Find $\Sigma d^2 = 286$.

iv. Find S - standard deviation.

$$S = \sqrt{\frac{n\sum d^2 - \left(\sum d\right)^2}{n}} = \sqrt{\frac{18 \times 286 \times 22^2}{18}}$$

$$= \sqrt{\frac{5148 - 484}{18}} = \sqrt{\frac{4664}{18}}$$

$$= 16.097$$

r substitute for the formula: $t = \frac{\bar{d}\sqrt{n-1}}{S}$

$$= \frac{1.22\sqrt{7}}{16.097} = \frac{5.038}{16.097} = 0.313$$

Decision: $t_{cal} = 0.313$, t_{tab} at (17: 05) - 2.131

Since t_{cal} is less than t_{tab} (critical value), we ACCEPT that there are no significant difference in the results, **OR** that the results are not significantly different.

3.5.4 Testing Hypothesis about Correlations

In the sections you have studied, you have seen how t-test can be used in different forms. You will have to note that when hypotheses testing involve the use of correlation coefficients, there are two ways to test them. The first which you are familiar with is to use the table and find out if the correlation coefficient is significant.

The second is that, instead of using the correlation coefficient directly from the table, you can subject it further to a t-test. In this case,

$$t = \sqrt{\frac{1-r^2}{n-2}} \quad \text{or} \quad t = \frac{\sqrt{n-2}}{1-r^2}$$

Example 4

A teacher wanted to find out whether students' scores in Technical Drawing have any significant relationship with their scores in Mathematics. He used the Pearson Product Moment Correlation Coefficient to do this. He came out with a correlation coefficient of r - 0.60, N = 50.

To find out if this is significant:

i. Propose a null hypothesis: The students' scores in Technical Drawing and Mathematics are not significantly related. **OR,** There is no significant relationship between the students' scores in both Mathematics and Technical Drawing.

ii. Substituting with the formula:

$$t = \frac{\sqrt{n-2}}{1-r^2} = 0.60\frac{\sqrt{50-2}}{\sqrt{1-0.60^2}} = \frac{0.60\sqrt{48}}{\sqrt{0.64}}$$

$$= \frac{4.1569219}{0.8}$$

$$= 5.196$$

iii. Find the critical value by using t(50 – 1 : @ 0.05) = 2.021.

iv. Since t_{cal} is greater than t_{tab} i-e. 5.196 > 2.021, we reject the null hypothesis and say the students* scores in Mathematics and Technical Drawing are significantly related.

SELF-ASSESSMENT EXERCISE

In a research study, it was found that the correlation coefficient of two variables was 0.72 and the number of the respondents was 50. Propose a null hypothesis and test it using this information at 0.05 levels.

3.6 Analysis of Variance (ANOVA)

In the sections earlier, you studied the t-test and its uses in verifying hypotheses. In the test for hypothesis, we can also apply the analysis of variance (ANOVA) which is referred to as Fishers Test (F-test).

It is a more versatile test which can be used where two or more variables are involved for comparison. You can see that if more than two groups or variables are involved the z or t-tests cannot be used; ANOVA is used to determine the interaction effect of two or more variables, especially when the means of the sampled groups differ between and/or among the groups.

Example 5:

Scores of three randomly selected groups of students in an English test are given below.

GP 1	15	20	12	10	9	7	6	11	18	14	5
GP2	13	12	15	19	20	11	8	14	10	9	4

GP3	18	16	13	9	8	4	20	18	12	7	10

Test the hypothesis that the three groups do not belong to the same population.

S/N	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_3}$	$\mathbf{X_1^2}$	$\mathbf{X_2^2}$	$\mathbf{X_3^2}$
1	15	13	18	225	169	324
2	20	12	16	400	144	256
3	12	15	13	144	225	169
4	10	19	9	100	361	81
5	9	20	8	81	400	64
6	7	11	4	49	121	16
7	6	8	20	36	64	400
8	11	14	18	121	196	324
9	18	10	12	324	100	144
10	14	9	7	196	81	49
11	5	4	10	25	16	100
$\underline{\Sigma}$ X	**127 11.55**	**135 12.27**	**135 12.27**	**1701**	**1877**	**1927**

Find:

1. $\Sigma X_1 = \Sigma X_1 + \Sigma X_2 + \Sigma X_3$ = 127 + 135 + 135 = **397**
2. $\Sigma X^2{}_1 = \Sigma X^2{}_1 + \Sigma X^3{}_2 + \Sigma X^3{}_3$ = 1701 + 1877 + 1927 = **5505**
3. N_1 = $N_1 + N_2 + N_3$ = 11 + 11 + 11 = **33**

We shall take the correct factor to be $\frac{\left(\sum X_1\right)^2}{N_1}$ = $\frac{(397)^2}{33}$

4. Sum of squares total (SS_t) = $\sum X_1{}^2 - \frac{\left(\sum X_1\right)^2}{N_1}$ = $5505 - \frac{157609}{33}$

= 5505 – 4776.03 = **728.97**

5. Sum of squares, between group (SS_b):

$$SS_b = \frac{\left(\sum X_1\right)^2}{N_1} + \frac{\left(\sum X_1\right)^2}{N_2} + \frac{\left(\sum X_1\right)^2}{N_3} - \frac{\left(\sum X_1\right)^2}{N_1}$$

$$= \frac{127^2}{11} + \frac{135^2}{11} + \frac{135^2}{11} - \frac{397^2}{33}$$

= 1466.2727 + 1656.8182 + 1656.8182 – 4776.03

= 4779l9091 – 4776.03 = **3.891**

6. Sum of squares within group (SS_w): $SS_w = SS_t - SS_b$ = 728.97 – 3.8791 = **725.09**

7. Degree of freedom, between (df_b) = K – 1 = 3 – 1 = **2**.
8. Degree of freedom, within (df_w) = N – K = 33 – 3 = **30**.
   Where N = total number of sample
9. Variance, between groups (V_w) = $\frac{SS_b}{df_b}$ =

   $\frac{3.8791}{2}$

   =

   1.94
10. Variance, within groups (V_b) = $\frac{SS_w}{df_w}$ =

    $\frac{725.09}{30}$

    =

    24.17
11. F – ratio = $\frac{V_b}{V_w}$ = $\frac{1.94}{24.17}$ = **0.08**
12. Determine the critical value of F.

From the calculation df_b, = 2 and df_w = 30, go to the F-table and find the point of intersection of 2 and 30 at 0.05 level. This will give you the F-value i.e. 3.32.

13. Decision: F - value calculated = 0.08
F - value critical = 3.32

Since the calculated value is less than the critical value for the degrees of freedom 2 and 30, and alpha level of 0.05, we ACCEPT the null hypothesis that the scores are not significantly different.

For the purpose of presenting the result in a research report, a summary of the results is shown in a table while the computations are shown in the appendix. Thus:

Sources of Variation	**Sum of squares**	**Degree of freedom**	**Variance**	**Fcal**	**F-crit**	**Decision**
Between groups	3.8791	2	1.94	0.08	3.32	Accept ho
Within groups	725.0900	30	24.17			
Total	**728.9691**	**32**				

Self Assessment Exercise

S/N	1	2	3	4	5	6	7	8	9	10
X_1	6	7	13	8	12	5	10	6	9	11
X_2	15	14	10	12	13	11	14	10	12	13
X_3	5	8	10	15	4	13	7	13	6	9
X_4	10	7	5	8	9	8	6	4	7	3

Use the data above to verify a null hypothesis at 0.05.
Now that you have seen ANOVA and how to use it, we can now go to the next test. But before we do that, you have to note that ANOVA can be one-way as in the example given, two-way or multiple ANOVA. We are not going to discuss these other ones here. However, you will meet them including ANCOVA - analysis of covariance in your master's degree programme. For now, let us turn to the chi-square.

3.7 The Chi-Square

The word chi is pronounced kai. The chi-square is a test of independence which is used for analyzing data that are in the form of frequencies occurring in two or more mutually exclusive or discrete variables being compared. The test allows us to determine whether or not a significant difference exists between the observed frequencies of cases in each category of variables studied versus the expected frequencies or data or number of cases in each category of variables based on the null hypothesis. The observed frequency is data obtained from the actual frequency count while the expected is the data that would be obtained if equal numbers responded to the same variables equally. The larger the margin between the observed and the expected frequency counts, the higher the chi-square value. You can compare the calculated chi-square against a given critical value to determine whether it is significant. The formula for chi-square is:

$$x^2 = \frac{\sum (f_0 - f_e)^2}{f_e}$$ where f_0, is the observed frequency, and f_e is the expected frequency in each cell.

Example 6:

A survey to determine the preference pattern of some parents on the choice of courses for their children is given in a table below. Use a null hypothesis to determine whether the indicated preference pattern is statistically significant.

Frequency	Business	Law	Medicine	Engineering	Total
Observed	24	50	52	34	160
Expected	40	40	40	40	160

Steps:

i. State the null hypothesis H_0: There is no significant difference between the expected and observed preference pattern of the parents at 0.05 alpha levels.

ii. Apply the chi-square formula in each cell and sum up at the end.

1. For Business $= \frac{(O-E)^2}{E} = \frac{(24-40)^2}{40} = 6.4$

2. For Law $= \frac{(O-E)^2}{E} = \frac{(50-40)^2}{40} = 2.5$

3. For Medicine $= \frac{(O-E)^2}{E} = \frac{(52-40)^2}{40} = 3.6$

4. For Engineering $= \frac{(O-E)^2}{E} = \frac{(34-40)^2}{40} = 0.9$

$\therefore \quad x^2 = \frac{\sum (O-E)^2}{E} = 6.4 + 2.5 + 3.6 + 0.9 = 13.4$

To take decision on the significance of the x^2 value, you have to find the degree of freedom *df*. The example discussed above is a one-variable case, so the *df* is given by: df = K - 1, i.e. (4 - 1) = 3. As usual, go to the chi-square table and look under df = 3, and your alpha level, which can be 0.05 or 0.01. Again, if the calculated value exceeds the value on the table, you reject the null hypothesis. In this case x^2 at 3 : 0.05 - 7,82. This is less than the calculated value, so we reject the null hypothesis.
Most of the times, researchers are confronted with the test for the independence of two variables. For instance, gender and opinion, or religion and choice or age and opinion. Again, each of the variables may have two or more levels. The observed and the expected frequencies arc presented in a table called contingency table. It has a number of rows and columns.

Example 7:

The enrolment pattern of students to different academic programmes according to religion is given in the table below. Calculate the chi-square and test for the significance at 0.05.

Religion	**Academic Programmes**				
	Business	**Law**	**Medicine**	**Engineering**	**Totals**
Christianity	50	35	48	45	178
Islam	30	45	35	50	160
Traditional	45	30	25	40	140
Godian	25	20	30	28	103
Totals	**150**	**130**	**138**	**163**	**581**

To solve this problem, take the table above as the table of the observed frequencies. Therefore, you will need the table for the expected frequencies. To find the expected frequency for each cell, apply the formula:

$$\frac{\text{column total} \times \text{row total}}{\text{overall total}}$$

Example, for cell 1, where the observed is 50, the expected is given by $\frac{150 \times 178}{581} = 45.96$.

For the next cell where the observed as 35, the expected is given by $\frac{130 \times 178}{581} = 39.83$ etc.

The expected frequencies are better presented in a table like the observed. See the table below

Religion	**Academic Programmes**				
	Business	**Law**	**Medicine**	**Engineering**	**Totals**
Christianity	45.96	39.83	42.28	49.94	178
Islam	41.31	35.80	38.00	44.89	160
Traditional	36.14	31.33	33.25	39.28	140
Godian	26.59	23.05	24.46	28.90	103
Totals	**150.0**	**130.01**	**138.00**	**163.01**	**581**

To get the chi-square value, we use $\frac{\sum (O - E)^2}{E}$

Instead of taking the cells one by one, we use a table to do the same thing in a short time. Let us use a table to calculate the chi-square.

O	E	O-E	$(O-E)^2$	$(O - E)^2/E$
50	45.96	4.04	16.32	0.36
30	41.31	-11.31	127.92	3.10
45	36.14	8.86	78.50	2.17
25	26.59	-1.59	2.53	0.10
35	39.83	-4.83	23.33	0.59
45	35,80	9.20	84.64	2.36
30	31.33	-1.33	1.77	0.06
20	23.05	-3.05	9.30	0,40
48	42.28	5.72	32.72	0.77
35	38.00	-3.00	9.00	0.24
25	33.25	-8.25	68.06	2.05
30	24.46	5.54	30.69	1.25
45	49.94	-4.94	24.40	0.49
50	44.89	5.11	26.11	0.58
40	39.28	0.72	0.52	0.01
28	28.90	-0.90	0.81	0.03
				14.56

From the calculation shown above, the calculated value is:
x = 14.56, df = (c - 1) (r - 1) - (4 - 1) (4 - 1) - 9.

For decision, go to the table to look for the critical value at df = 9, alpha = p = 0.05. X 2tab -16.92.

Since the calculated value of 14,56 is less than the critical value of 16.92, we Accept the null hypothesis that there is no significant difference between the observed values and the expected values.

Self Assessment Exercise
Use the data below to verify your proposed null hypothesis:

Gender	**VX**	**VY**	**VZ**	**Total**
Male	55	40	50	145
Female	35	25	40	100
Total	90	65	90	245

4.0 CONCLUSION

Now that you have successfully worked through this unit on how to test hypotheses, you are now prepared to carry out your research project work. But before you go properly into that, we shall introduce you to how to write research reports in the next unit.

5.0 SUMMARY

In this unit, we have discussed the selection of the alpha level or significance level and we said the two most common alpha levels used in research are 0.05 and 0.01. We touched upon the degrees of freedom, Type J error and Type II error as the likely errors that can be made in decision making in the test of hypothesis.

Hypotheses can be frame in two formats, which are directional and non-directional. This implies that we have two types, vis-a-vis one tailed test and two tailed test. You also studied the different types of tests used in testing hypotheses. The t-test, the F-test and the chi-square are the prominent. In the next unit, you will be introduced to how to write your research reports.

6.0 TUTOR-MARKED ASSIGNMENT

A class of students did a test in Introduction Technology when they were in JS.2. The same class of students studied Technical Drawing in their SS.2. The results are given in the table below. What is the correlation coefficient of these sets of scores? Propose a null hypothesis and verify it using t-test on the result of the correlation coefficient.

S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Introduction Technology	20	18	17	25	22	15	13	10	19	24	16	8	5	14	12
Technical Drawing	25	20	18	24	20	17	18	15	19	20	20	12	10	22	14

7.0 REFERENCES/FURTHER READING

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UNIT 6 RESEARCH REPORTS WRITING

1.0 INTRODUCTION

The final stage of any research process is the writing of the research report. Research is very important, because the findings generated can be used for rational decision-making and, according to Nkpa (1979), as a springboard for further research.

The main aim of writing research report is to communicate or disseminate the research findings to the literate audience. In writing the research report, the impersonal mode is preferred. That is to say, instead of say “I did this”, you should say “the study was carried out to do this”. You will have to note that in presenting a research report, you have to use the required format. Most institutions have their own format. These formats or house-styles do not vary significantly from the general format. National Open University of Nigeria (NOUN), School of Education, has its own house-style. You supervisor will let you have it. For the purpose of this unit, we shall discuss the general format.

2.0 OBJECTIVES

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

- explain the chapter titles and sub-titles in a research project report;
- prepare a research report based on the given format.

3.0 MAIN CONTENT

3.1 Sample Format of a Research Report

As you have seen in the introduction, a research project report is a detailed account of what the researcher has done in the process of carrying out the research the findings of this study. The report is not presented in any form. It follows an agreed format as summarized below. This format is only a guideline. Though this is the conventional format, only relevant section should be used in line with your house-style.

1. Preliminary pages:

i. Title page
ii. Approval / Acceptance page
iii. Certification page
iv. Dedication
v. Acknowledgement page
vi. Abstract
vii. Table of Contents
viii. List of tables
ix. List of figures
x. List of appendices

2. Chapter 1: Introduction

i. Background to the Problem
ii. Statement of the Problem
iii. Purpose / Objectives of the Study
iv. Significance of the Problem
v. Scope of the Study
vi. Research Questions and/or Hypotheses
vii. Definitions of Terms

3. Chapter 2: Literature Review

i. Review of Related Literature
ii. Conceptual Framework

4. Chapter 3: Research Methodology

i. Research design
ii. Population
iii. Samples and Sampling techniques
iv. Instrumentation - construction of instruments, validation, reliability of instruments, administration and scoring
v. Methods of data analysis

5. Chapter 4: Presentation of Results

i. Data analysis and findings
ii. Summary of major findings

6. Chapter 5: Discussion

i. Interpretation of findings
ii. Discussion of findings
iii. Implication of the study
iv. Recommendations
v. Limitations
vi. Suggestions for further study

7. Supplementary page:

i. Bibliography
ii. Appendices
iii. Index

3.2 Steps in Research Report Format

You have already noted that a research report is a straight forward, clearly and precisely written document in which you attempt to explain how you have resolved the problem before you. The presentation, in this unit, is consistent with the most acceptable formats. So let us explain them.

3.2.1 Preliminary Pages

i. ***The title page:*** This is the first page of this section. It contains the title of the study, the name of the author, the relationship of the research to a course or degree requirement, name of the institution where the report is to be submitted, and the date of presentation.

The title should be concise and state clearly the purpose of the study. The essential elements to be included in the title are the major variables

and the target population. These should be phrased in such a way as to describe what the study is all about. You should not state your title so broadly that it may claim more than it can actually deliver. For instance, sex differences in the enrolment of S.S.C.E. candidates in Technical Drawing from 2004 to 2007, or the effect of group discussions on learning outcomes in the Open and Distance Education system. You can note the variables here. The title should be typed in capital letters, single-spaced, and centered between the right and left margins of the page.

ii. ***Approval/Acceptance page:*** The specifications vary from institution to institution. It contains some of the following information; the names, signatures of the head of department, the dean, the supervisors) and dates, the names(s) of the student(s).

iii. ***Certification page:*** This contains the attestation of originality of the research project. It may also include the name and signature of the external examiner.

iv. ***Dedication:*** Here, emotionally-lad en words may be permitted in order to pay tribute to persons who are dear to the author or those who contributed in one way or the other to the success of the project and those who would particularly be interested m the research findings.

v. ***Acknowledgement page:*** This is used to express gratitude to those who helped in the process of conducting the research and preparing the report. It should be simple and restraining.

vi. ***Abstract:*** This is a succinctly summarised form of the report containing the aim of the investigation, the sample, methods of investigation, the instruments used for data collection, the analysis and findings.

vii. ***Table of Contents:*** This serves an important purpose of providing the outline of the contents of the report. It lays out in a tabular form, the chapters, headings and subheadings of the report. It is sequentially arranged and numbered from the preliminary to the supplementary pages. Page references for each topic are so indicated.

viii. ***List of tables and figure and appendices:*** If tables and/or figures are used in the report, a separate page is included for each list. It should indicate the page numbers in which the tables or figures presented in the report are located. The numbers and titles are serially listed. Also contained is the list of appendices that are embodied in or annexed to the report.

The pages of the preliminary section are numbered with lower-case Roman numerals (i, ii, iii, iv, v, etc).

3.2.2 Introduction

i. ***Background to the Problem:*** Here, such factors or circumstances that informed the investigation are traced. It is presented using reasoned statements to show that it is worthwhile to dissipate resources to carry out the study. It shows the nature, scope, and current status of the factors affecting the problem. It has to be presented in a way as to be clear and convincing to the reader.

ii. ***Statement of the Problem:*** The problem as already highlighted is stated in simple, clear and unambiguous terms. This is not required to be too long.

iii. ***Purpose of the Study/Objectives of the Study:*** These go interchangeably, but it states the specific aspects of the study and the reasons for focusing on them. It includes statements of what should be accomplished and all that would be investigated.

iv. ***Significance of the Problem:*** The usefulness, the utility value of the research or findings of the research should be articulated. The institutions, groups or individuals who are expected to profit or benefit and the benefits expected to accrue to them are to be stated in this section.

v. ***Scope of the Study:*** This is interchanged with the delimitation of the study. Here, you will have to indicate the extent to which the study will be covered. It involves the geographical area, time period, and variables to be covered.

vi. ***Research Questions and/or Hypotheses:*** These are formulated based on the type of research and the variables under investigation. They should be formulated to provide answers to the problems under study.

vii. ***Definitions of Terms:*** The essence of definition is to ensure that the reader understands the specific meanings ascribed to the terms by the author So you have to use this to educate the readers on the operational meaning of any coined, technical words, phrases or expressions which cannot otherwise be understood because of their unconventional usage.

3.2.3 Literature Review

i. ***Review of Related Literature:*** This is the second chapter of your project report. It is meant to give the reader an understanding of some of the works or study already carried out in the area of the project. It will also give the reader an overall picture of the problem you are solving. You are therefore required to review only the important literature related to your study, abstract previous research studies and review significant writings of authorities in the area under study.

By so doing, a background for the development of your study will be provided. It will also bring the reader up-to-date. Apart from providing evidence of the investigator's knowledge of the field of study, it highlights the areas of agreement or disagreement in findings or gaps in existing knowledge.

Do not use the article-by-article presentation in your literature review. In other words, do not collect abstracts of previous researches and string them together without any attempt at continuity or logical organisation. Again do not make excessive use of quotations. Quotations are used only when the material quoted is especially well written and can be inserted without spoiling the continuity of the presentation (Olaitan and Nwoke, 1988).

ii. ***Conceptual Framework:*** This states the concept that informed the study. These concepts such as system concept, management by objectives concept, etc. will assist you to bring out salient points that would assist to important literature related to your study, abstract of previous research studies and review significant writings of authorities in the area under study.

3.2.4 Research Methodology

i. ***Research design:*** This lays out the master-plan for the research project. It shows the extent to which extraneous variables were controlled or eliminated. You should therefore describe any plan used clearly, even if it cannot be classified under a conventional label. All lapses should be reported as a limitation.

ii. ***The Population:*** You should specify all the necessary parameters to ensure that the constituents and characteristics of the target population are unambiguous. The target population may be people, animals, objects or events.

iii. ***Samples and Sampling techniques:*** The size of the sample and how the sample was selected should be so described in such a way as not to leave the reader in doubt about what you have done. Do not just say 100 respondents were randomly selected from the population. Specify the method in which the simple random sampling was used. Is it by the use of table of random numbers, describe whether pieces of numbered papers were jumbled in a box and picked up at random, etc.

iv. ***Instrumentation:*** In this section, you have to describe in full details the tools for data collection. Such tools like questionnaire, attitude scales, tests, etc. should be fully described to show their characteristics. You will have to report the reliability indices and validation procedures. Where you used a standard instrument, in

your report, you have to give the rationale for the appropriateness. Where a new instrument is developed, you have to outline the necessary procedures followed in both the construction and validation,

v. ***Data Collection:*** What methods did you use in your data collection? Did you use research assistants? If yes, did they undergo training? Did you collect the data personally, or by post? What problems did you encounter in the process of data collection? All the steps which you have taken to ensure the collection of valid that should be reported.

vi. ***Methods of data analysis:*** In this section, you will describe the techniques which you applied in the data analysis and the reasons for the choice. The reasons may be in relation to the type of design, nature of the samples on the type of data. Try to use the simplest, well known method of data analysis. But where you use a mode of analysis not widely known details of such method should be reported.

3.2.5 Results and Discussion

i. ***Presentation and Analysis of data:*** This is the heart of the research report. The results are clearly and concisely set out using the most illuminative modes of presentation. Tables, figures, graphs and textual descriptions are used to clarify significant relationships. They should be serially numbered and titled so as to be self explanatory. They should be simple and should be directly related to the hypotheses and/or the research questions.

ii. ***Interpretation of the finding:*** The most important task which you have to undertake in writing the results of your study is to identify and interpret the major findings. You should be able to discuss possible reasons why the results occurred the way they did. You should try to fit them into the findings of previous research, suggest the applications to the field and make theoretical interpretations.

3.2.6 Summary and Conclusions

i. ***The Summary:*** In this section, you should clearly and concisely restate the problem, the hypotheses and/or research questions, the main features of the method omitting most of the details concerning the subjects and measures and list the main findings.

The summary must be very brief, but consistent with a clear presentation of all important information about the problem, method and findings. The findings should be listed by number. You should summarize each major finding in one or two statements.

ii. ***The Conclusion:*** This gives answers to the questions raised or the statements of acceptance or rejection of the hypotheses. It should be based solely on the findings generated by the research.

iii. ***Implication of the study:*** In this section, you may include ideas on the relevance of the findings to educational theory and practice. But these ideas should be directly be derived from the study.

iv. ***Suggestions for further study:*** It may be appropriate here to suggest areas of problems for further investigation. This is made as a result of matters arising from the research.

3.2.7 Supplementary Pages

i. ***Bibliography:*** In this section, you should include all references cited in the report and those not cited, but consulted to shed light on the problem, References are cited uniformly and according to a given style.

Most universities adopt the APA format. References are done serially and alphabetically. You can look for the APA format and go through it.

ii. ***The Appendices:*** This contains extra information which is part of the report the reader should know about, but not necessarily for inclusion in the main report. They include long tables, forms, instruction aids, data collecting instruments, items analysis data, scoring protocols and procedures, lengthy quotations etc.
Each separate entry heading is listed as APPENDIX A, APPENDIX B, etc.

SELF-ASSESSMENT EXERCISE

Go to any university library and select three different research projects. List the items on the table of content and compare them.

4.0 CONCLUSION

At the end of your programme, you are expected to carry out a research. At the end of the research, you are also expected to submit a written report of the investigation. In this unit, you have gone through the involvement in the writing of the report. A very important demand here is that you must be as objective as possible in your report. At the initial stage, you cannot make any statement that would show you are in favour or against an idea. Your report should be devoid of emotional or subjective statements. You should arrange the different parts of the

report so as to make it possible for a reader to easily locate any section of particular interest to him,

5.0 SUMMARY

In this unit, we have discussed and presented a sample format of a research report. We have also discussed these steps in details stating from the preliminary stages to the supplementary stages. We have emphasised that your reports should not be presented with personal pronouns like I, my, we etc. Instead use impersonal pronouns and passive voice. You should make sure that the report is written in a clear, simple and straightforward style. Your motive should be effective communication. Therefore, use very simple language. You should always be brief so as not to bore your reader. Abbreviations should only be used after they have been written in full earlier.

Avoid the use of generalisations or conclusions, which are not supported by the findings. We also said that every source cited in the work or used but noted cited in the work should be documented in the reference page. Improper citation or inability to give details of a source cited in the body of the work should be documented in the reference page. Improper citation or inability to give details of a source cited in the body of the work should be avoided. Remember that proofread the report thoroughly after typesetting. This will help you not to submit avoidable errors. Congratulations for being part of the success story of NOUN, and for graduating in this programme.

6.0 TUTOR-MARKED ASSIGNMENT

Pick up any four (4) research projects. Study the abstracts. What are the things that are common to all of them?

7.0 REFERENCES/FURTHER READING

Ali, A. (1996). *Fundamentals of Research in Education*. Awka: Meks Publishers (Nigeria).

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