SEMESTER -I COURSE CODE: MS1TC1

BASICS IN EDUCATIONAL RESEARCH

UNIT-I: INTRODUCTION TO EDUCATIONAL RESEARCH

Research – meaning, objectives of Research- Characteristics, Scope and Need for research, Ethics in doing Research – Plagiarism and its consequences – Research Proposal

What is Research?

'Research' generally conveys 'search for knowledge'. It is an art of scientific investigation. Research is an orderly investigation of a problem to add something to the existing knowledge. Research is a systematic investigation or study of materials and sources to establish facts and reach new conclusions. UNESCO (1962) defined research as "the orderly investigation of a subject matter to add to knowledge". The Advanced Learner's Dictionary of Current English says, Research is a careful investigation or inquiry specially through the search for new facts in any branch of knowledge".

According to Creswell "Research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue". Research is a scientific process. It is called scientific because its results are verifiable. It is a systematic search for answers to questions about facts and relationship between facts. Research has a systematic method and order and follows an acceptable procedure. Through research, the researcher develops a body of knowledge. A research approach is a scientific approach to problem-solving. Research methodology and techniques will help the researcher to develop an objective attitude toward all life situations. An understanding of research helps the researcher to read professional journals, articles, abstracts, educational journals etc. The quality of education should be enriched through research. According to Redman and Mory, "Research is a systematized effort to gain new knowledge".

Research is an academic activity. It is a movement from the known to the unknown. It is a voyage of discovery. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last, carefully testing the conclusions to determine whether they fit the formulating hypothesis.

D. Slesinger and M. Stephenson in the Encyclopaedia of Social Sciences defines research as "the manipulation of things, concepts or symbols to generalize to extend, correct or verify knowledge, whether that knowledge aids in the construction of theory or the practice of an art."'

Research is, thus, an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit (search) of truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through an objective and systematic method of finding a solution to a problem is research. The systematic approach concerning generalization and the formulation of a theory is also research.

Describe the etymological meaning of Research?

The word research is derived from the Middle French "recherche", which means "to go about seeking". The term itself being derived from the Old French term "recerchier" a compound word from "re-" + "cerchier", or "sercher", meaning 'search'. Research is composed of two syllables a prefix, ***re*** and a verb **search. Re** means 'again', 'a new', 'over again'. Search means 'to examine closely and carefully', 'to test' and 'try', to probe (investigation)etc. The two words form a noun to describe 'a careful and systematic study in some field of knowledge undertaken to establish facts or principles'. 'Re- search' implying that the subject matter is already known but, for one reason or another, needs to be studied again. Research purifies human life. It improves the quality of life. It is a search for knowledge. It shows how to solve problems scientifically. It is a careful inquiry through the search for Knowledge. It is a journey from known to unknown.

It is a systematic effort to gain new knowledge. "Research is the voyage of discovery". It is the quest for answers to unsolved problems. Research is required in any field to come up with new theories or modify, accept, or nullify the existing theory. From time immemorial it has been seen so many discoveries and inventions took place through research and the world has got so many new theories which help the human being to solve his problems.

Definitions of Research

The Random House Dictionary of the English language defines the term 'Research' as a diligent and systematic inquiry or investigation into a subject to discover or revise facts, theories, applications, etc. This definition explains that research involves the acquisition of knowledge.

- L.V. Redman and A.V.H. Mory in their book on "The Romance of Research" defined research as "a systematized effort to gain new knowledge".
- "Research is a scientific and systematic search for pertinent information on a specific topic". (C.R. Kothari, Research Methodology - Methods and Techniques)
- "A careful investigation or inquiry specially through search for new facts in any branch of knowledge". (Advanced learners Dictionary of current English)

- Research is a systematic, intensive process of carrying on the scientific method of analysis. It involves a more systematic structure of investigation usually resulting in some sort of formal records of procedures and report of results or conclusions.
- Research is an organized investigation of a problem. In its broadest sense, it is an attempt to gain a solution to problems.
- Research is the studying of a problem in pursuit of a definite objective through employing precise methods, with due considerations to the adequate control factors other than the variable under investigation and followed by analysis according to be a statistical procedure. - APHA (1956)
- Kerlinger (1973) defined research as "systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among natural phenomena".
- According to Rekha Koul (2008), the nature of educational research is analogous to the nature of research itself, which is a "careful, systematic, reliable and valid method of investigating knowledge and solving problems" (Wiersma 1991)
- "Research is an abstraction and select from an infinite variety of possible things that one might study." - Gowin and Millman (1969)
- "Research has essentially been a problem-solving process, a systematic, intensive study directed towards full, scientific knowledge of the subject studied."- French Ruth M (1968)
- "Research may be defined as the systematic and objective analysis and recording of controlled observation that may lead to the development of generalizations, principles, theories, resulting in prediction and possibly ultimate control of events."- J. W. Best
- "Research may be defined as a planned, systematic search for information to increase the total body of man's knowledge. It involves looking for information which at the time is not available or for which that has no generally accepted evidence."- Arnold Lancaster
- "Research is a careful enquiry or examination in seeking facts or principles, a diligent investigation to ascertain something."- Clifford Woody
- C.C. Crawford: "Research is simply a systematic and refined technique of thinking, employing specialized tools, instruments & procedures to obtain a more adequate solution of a problem than would be possible under ordinary means."
- Webster Dictionary: "A careful inquiry or examination in seeking facts or principles, diligent investigation to ascertain something."

What are the Characteristics of Research?

Research is an activity that helps to generate knowledge. It helps in testing the existing knowledge and also helps in creating new knowledge. Following are the important characteristics of research. Research is essentially systematic inquiry and it can help us discover more effective ways of teaching and facilitating learning. Research concerned with problem-solving is also known as applied research. Most educational research is applied research because it is concerned with the formulation of procedures and sequences of action to achieve our purpose i.e. solving problems that we encounter as teachers.

Generation of Knowledge

Research helps in verifying existing knowledge and, if necessary, generate new knowledge. Research that leads to the generation of knowledge is very carefully planned and conducted in controlled situations.

Research is empirical (Scientific)

Research is a scientific process. Research is based on direct experience or observation by the researcher. Research is a systematic and critical investigation of a phenomenon. Why it is called scientific? Because it follows scientific methods, scientific procedures and arrives at a scientific conclusion. The entire process is scientific.

Research is logical

The research is based on valid procedures and principles. It follows logical methods and arriving at logical conclusions. It is based on empirical evidence and observable experience.

Research is Cyclical

The research starts with a problem and ends with a problem. It develops generalizations, principles or theories. It's directed towards finding an answer to the questions and solutions to the problems. It also leads to new solutions.

Research is Analytical

The research utilizes proven analytical procedures in gathering data, whether historical, descriptive, experimental, and case study.

Research is Critical

The research exhibits careful and precise judgment.

Research is Methodical

The research is conducted methodically without bias using systematic methods and procedures.

Research is Replicable

The research design and procedures are repeated to enable the researcher to arrive at valid and conclusive results.

Describe the Meaning of Educational Research

Educational Research is the systematic application of the scientific method for solving educational problems, regarding students and teachers as well. Educational Research involves individuals like teachers/students and educational institutions. It covers areas from formal education to nonformal education. Educational Research solves educational problems, purifies educative process and generates new knowledge.

Educational research is a systematic and objective process of analyzing the phenomena in the field of Education. Educational Research is that activity which is directed towards the development of a science of behaviour in educational situations. The ultimate aim of this research is to provide knowledge that will permit the educator to achieve his goals by the most effective methods. Educational research refers to a variety of methods, in which individuals evaluate different aspects of education, including "student learning, teaching methods, teacher training, and classroom dynamics".

It covers all studies concerning teaching and learning, teacher education, administration, guidance and counselling etc. Educational research carries the application of the scientific method to the study of educational problems or educational thought. The purpose of educational research is to solve educational problems. According to Mouly, "Educational Research is the systematic application of the scientific method for solving educational problems."

Travers thinks, "Educational Research is the activity for developing science of behaviour in educational situations. It allows the educator to achieve his goals effectively". According to Whitney, "Educational Research aims at finding out the solution to educational problems by using the scientific-philosophical method". Thus, educational research aims to solve the educational problem systematically and scientifically. In educational research, meaningful educational problems are identified and an attempt is made in a systematic, objective and deliberate manner to solve them.

What are the characteristics of educational Research?

Research is a mental process leading to the generation of new ideas or concepts. It is the process of associating and relating existing ideas or concepts with new ideas or concepts. Innovation is the key notion in the research process. Educational research is a broad term. It refers to a variety of methods in which individuals evaluate different aspects of education, including student learning, teaching methods, teacher training, classroom dynamics classroom management, school administration, study materials and transactional modalities.

Educational research must be conducted rigorously and systematically, although what this implies is often debated. Educational research follows an interdisciplinary approach. There are a variety of disciplines which are each present to some degree in educational research. These include psychology, sociology, anthropology, and philosophy.

- Any research is purposeful. But Educational Research is highly purposeful. Because it deals with the problems of students and teachers as well.
- It is a precise, objective, scientific and systematic process of investigation.
- It attempts to organize data quantitatively and qualitatively to arrive at statistical inferences.
- It generates new knowledge in the field of education
- It is based on the philosophy of education
- It depends on the researcher's ability, ingenuity and experience for its interpretation and conclusions.
- It needs an interdisciplinary approach to solving educational problems.
- It demands subjective interpretation and deductive reasoning in some cases.
- It uses classrooms, schools, colleges department of education as the laboratory for conducting research.

Gary Anderson outlined ten aspects of educational research. These can be classified into three categories, which are the purpose of research, the procedures of research, and the role of the researcher. The purposes of research are to solve the problems, investigate knowledge, and establish the principles in educational phenomena. In short, it focuses on solving problems and developing knowledge. Furthermore, the procedure is an important characteristic of educational research, which involves collecting data with accurate observation, objective interpretation, and verification. Finally, researchers need to be experts and familiar with their field of study, using the data to develop solutions and increase knowledge. The researchers also need to be patient and careful to use every step of research's procedures to achieve the purpose of research. The ten aspects of Gary Anderson are: -

- Educational research attempts to solve the problem.
- Research involves gathering new data from primary or first-hand sources or using existing data for a new purpose.
- Research is based upon observable experience or empirical evidence.
- Research demands accurate observation and description.
- Research generally employs carefully designed procedures and rigorous analysis.

- Research emphasizes the development of generalizations, principles or theories that will help in understanding, prediction and/or control.
- Research requires expertise—familiarity with the field; competence in methodology; technical skill in collecting and analyzing the data.
- The research attempts to find an objective, unbiased solution to the problem and takes great pains to validate the procedures employed.
- Research is a deliberate and unhurried activity which is directional but often refines the problem or questions as the research progresses.
- Research is carefully recorded and reported to other persons interested in the problem.

The chief characteristics of educational research as described by Lulla, Murty and Taneja in their book "Essentials of Educational Research" are presented below:

- Educational research is highly purposeful dealing with the problems of immediate and remote concern to the problems of teachers and educationists.
- Educational research follows a systematic process of investigation as precisely, objectively and scientifically as possible.
- Educational research involves the determination of the problem to be studied, formulation of hypotheses, gathering of information and necessary data from the concerned sources and using different tools of investigation.
- Educational research employs scientific methods, objective procedures, logical arguments and inductive reasoning.
- Educational research attempts to organize the data in quantitative and qualitative terms to arrive at the statistical inference.
- Educational research emphasizes the discovery of new facts or interpretation of known facts in a new perspective.
- Educational research has some underlying philosophic theory.
- Educational research depends on the ability, ingenuity and experience of the research for its conclusions and interpretations.
- Educational research demands an interdisciplinary approach to solve many of its problems.
- Educational research demands subjective interpretation deductive reasoning in some cases.
- Educational research uses classrooms, schools and departments of education as the laboratories for conducting experiments, studies and surveys

Describe the scope/area of Research?

Educational research covers a vast area and it can be looked upon and classified in many ways. Chief among them are the following:

Educational Research includes or covers the following fields:

- Learner and his problems
- Teaching-learning process
- Guidance and Counselling
- Textbooks
- Physically and mentally challenged children
- Educational Philosophy
- Objectives of Education
- Curriculum Organization
- Teaching Methods
- Problems of teachers, educational managers and parents

Describe the Need and Significance of Educational Research

The need and significance of educational research are:

- It helps in acquiring new knowledge about teaching, learning, classroom management, transactional modalities, education administration etc. Good and Scates say, "The task of science is to develop intelligence and the task of research is to develop science." Thus, the development of Intelligence and knowledge research is essential. Educational research uses the scientific method to study best practices in teaching.
- Educational research is a means to attain educational objectives. Educational research is a purposeful activity or process. It is very necessary for attaining educational objectives. It accelerates the rate of social change. Research finds out new inventions or discoveries which help to speed up social change.
- Educational research helps the researcher to know about national and international developments in the field of Education. It gives the researcher an idea about the latest developments in the field of education.
- Research is a modification process: Research gives scientific insight to curriculum makers to introduce reforms in the area. It gives teachers an idea of how to improve the classroom situation.
- It helps in administration: The Educational administration becomes effective by finding and implementing the solutions to many educational problems.
- It is an unavoidable necessity for teachers: Action-Research solves many problems and difficulties coming in the way of teachers. Thus, it is essential for teachers.

Describe the Purpose or Objectives of Educational Research

The main purpose or objectives of Educational Research is to diagnose educational problems and to find out its solutions. The purpose of educational research is also to develop new knowledge about the teaching-learning situation to improve educational practices. The assumption that the selection of transactional modalities should be based on research evidence and the emotional and cognitive development of the learner.

Educational research addresses the following aspects:

- To promote evidence-based (research-based) teaching practices.
- To enhance the credibility of the teaching profession
- To suggest innovative (best) teaching and learning strategies and to understand how students learn various subjects
- To identify what are the best practices for teachers to motivate their students to learn
- To identify the problem faced by learners and their emotional and cognitive developments
- To know about the best practices that make the classroom optimal for student learning

Describe the nature of Educational Research

Educational research refers to a systematic attempt to gain a better understanding of the educational process generally to improve its efficiency. It is an application of the scientific method to the study of educational problems.

Travers says "Educational research represents an activity directed towards the development of an organized body of scientific knowledge about the events with which educators are concerned. Of central importance are the behavioural patterns of pupils and particularly those to be learned through the educational process.

Education is behavioural science. So, the major concern of educational research is to understand and explain and to some degree predict and control human behaviour. It aims to develop an organized and useful body of scientific knowledge about educational practices. Authors of research take issue with the nature of educational research. One view is that educational research is an applied science or engineering research. It is an applied science in the sense that it is concerned with the realization of certain practical ends which have social value. They argue that the function of education is to transmit the ideology of culture, knowledge and intellectual skills. Another opinion is that education aims to help an individual in the optimum development of potentiality for growth and development -not

only concerning cognitive abilities but also concerning personality organization and adjustment.

Write A Short Note About the Ethical Principles for Research

In education, research is important. The entire educational process revolves around research and its associated activities. A researcher must follow an ethical code of conduct while conducting research. The following are some ethical considerations:

- A researcher may have responsibilities to his or her client when conducting research.
- If the study is funded, the researcher must adhere to certain commitments to the sponsoring organization.
- If a researcher receives financial assistance, the researcher must fulfil those commitments to the banker.
- The researcher must adhere to his or her responsibilities to society, the subjects (sample/respondents), and professional peers.
- Data that may lead to unfavourable assumptions and interpretations for the sponsoring agency should not be discarded.
- The details gathered from the respondents should be kept strictly confidential by the researcher.
- Without the respondents' permission, no information about the respondents' data should be disclosed in any documents, reports, or to other individuals.
- All participants in the study should give their consent and have their interests protected by the researcher.
- Without the consent of the respondents, the researcher should not use hidden cameras, microphones, tape recorders, or observers.
- In an experimental study, the researcher should give the participants a thorough explanation of the procedures.
- The length, disposition, and position of participants in the study, as well as any risk factors that may exist, are all factors to consider.
- Parents' or guardians' permission should be sought if the study involves minor school children or mentally ill students. This is referred to as "informed consent." The researcher must agree that the subjects have the right to refuse to participate or withdraw from the study at any time.
- The researcher should never attempt to make unnecessary attempts to ensure the subjects' inclusion and the experiment's continuity (money, marks, offers etc.)

- To protect the participants from mental and physical damage, threat, and stress, the researcher must take all reasonable precautions.

The researcher should make his data publicly accessible for peer review.

All those who assisted the researcher with the research process, tool creation, data collection, data analysis, or research report preparation should be acknowledged.

General ethical principles involved in Research

Honesty: The researcher should follow the principle of honesty. Honestly should be in the collection of data, methods and procedures, results, and publication. Do not fabricate, falsify, or misrepresent data. Do not deceive (cheat) participants, funding agencies, or society.

Objectivity: The researcher should follow the principle of objectivity. He/she should be free from bias in preparing a research design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research where objectivity is expected or required. Avoid or minimize bias or self-deception (dishonesty). Interest in personal or financial matters may affect the quality of research.

Integrity: Keep your promises and agreements; act with sincerity; strive for consistency of thought and action.

Carefulness: The researcher should avoid careless errors and negligence. He /she should carefully and critically examine his/her work and the work of others. Keep good records of research activities, such as data collection, research design, and correspondence with agencies or journals.

Openness: Be open-minded and share data, ideas, tools, resources and results with others. Be open to criticism and new ideas.

Respect for Intellectual Property: Honor patents, copyrights, and other forms of intellectual property. Do not use unpublished data, methods, or results without permission. Give credit where credit is due. Give proper acknowledgement or credit for all contributions to research. Never plagiarize.

Confidentiality: Protect confidential communications, such as papers or grants submitted for publication, personnel records, data, and participants' records.

Responsible Publisher: Publish your research findings for the progress of the society and further advancement for research. Avoid wasteful and duplicative publication.

Responsible Mentoring: Help researchers, and students for research.

Respect Social Responsibility: Do not publish anything that may harm to the society.

Non-Discrimination: Avoid discrimination on the basis of sex, race, ethnicity, or other factors.

Competence: Maintain and improve your own professional competence and expertise through lifelong education and learning.

Legality: Know and obey relevant laws and institutional and governmental policies.

Animal Care: Show proper respect and care for animals when using them in research. Do not conduct unnecessary or poorly designed animal experiments.

Human Subjects Protection: When conducting research on human subjects minimize harms and risks and maximize benefits; respect human dignity, privacy, and autonomy.

The following are some other legal concerns:

- submitting the same paper to two journals without informing the editors
- submitting the same article under various titles to different journals
- Removing the co-name author's
- Inclusion of a person's name as a co-author in a paper in exchange for a favor, even though the colleague did not make a significant contribution to the paper
- Taking out parts of a piece of paper
- Using an erroneous statistical technique to increase the importance of a study
- Publish papers without going through the peer review process.

UNIT-II: CLASSIFICATION OF RESEARCH

Classification Based on Data type – Quantitative, Qualitative - Classification based on Purpose – Pure or Fundamental, Applied, Action - Classification based on Method- Historical, Philosophical, Diagnostic studies, Experimental studies, Ex-Post Facto Research, Case study, Survey– Survey.

A. Classification Based on Data type – Quantitative, Qualitative

Based on data type research methods in education are broadly divided into two main types: quantitative and qualitative methods.

What is Quantitative Research?

Quantitative research is a research method employed to gain new knowledge. It is based on the measurement of quantity or amount. Quantitative research is a type of empirical (experimental) investigation. Here the researcher focuses on verifiable observations as opposed to theory or logic. Most often this type of research is expressed in numbers. Here the researcher manipulates certain observations to see the result. The overall goal is to convey numerically what is being seen in the research and to arrive at specific and observable conclusions.

Quantitative research method gives a numeric or statistical approach to research design. It applies to phenomena that can be exposed in terms of quantity. Quantitative research emphasizes objective (impartial or unbiased) measurements. It uses statistical, mathematical, or numerical analysis of data collected through polls (ballots), questionnaires, and surveys by manipulating pre-existing statistical data using computational techniques. Quantitative research begins with a problem statement and involves the formation of a hypothesis, a literature review, and a quantitative data analysis. Creswell (2003) states, quantitative research "employ strategies of inquiry such as experiments

and surveys, and collect data on predetermined instruments that yield statistical data". The findings from quantitative research can be predictive, explanatory, and confirming.

Quantitative research designs are either surveyor experimental. A surveystudy establishes an only association between variables; an experimental study establishes causality (Both Cause and Effect). Creswell, (2002) asserts that quantitative research originated in the physical sciences, particularly in chemistry and physics. The researcher uses mathematical models as the methodology of data analysis. Quantitative research is the numerical representation and manipulation of observations to describe and explain a phenomenon. It is used in a wide variety of natural and social sciences, including physics, biology, psychology, sociology and geology.

Characteristics of Quantitative Research

- Quantitative research aims to test hypotheses & make predictions.
- The variables are randomly selected. But specific variables are studied.
- For data collection numbers and statistics are used.
- Data collected based on precise measurements using structured & validated data-collection instruments.
- Method of analysis is the identification of statistical relationships
- In quantitative research objectivity is critical.
- Researcher & his biases are not known to the participants in the study.
- Quantitative research focuses on verifiable observation as opposed to theory or logic.
- Most often this type of research is expressed in numbers.
- The researcher manipulates certain observations that he is studying.
- The researcher determines what changes may reflect.
- Based on the study, the researcher will reach specific and observable conclusions.

- The researcher analyses numerical data and generalizes it.
- The researcher has a clearly defined research question to which objective answers are sought
- All aspects are carefully and precisely designed before data collection/ data is usually gathered using structured research instruments.
- Data are in the form of numbers and statistics
- The results are based on larger sample sizes that are representative of the population.
- The research study can usually be repeated.
- The researcher has a clearly defined research question to which objective answers are sought.
- The researcher uses tools, such as questionnaires or computer software, to collect numerical data.
- The researcher classifies features, count them, and construct statistical models in an attempt to explain what is observed.

Types of Quantitative research

Quantitative research designs are either experimental or non-experimental (descriptive)

The four types of quantitative research are

1. Surveyresearch
2. Correlational research
3. Causal-comparative research
4. Experimental Research

Write a short note about Qualitative Research

Meaning of Qualitative Research

Qualitative research can be defined as a type of scientific research that tries to bridge the gap of incomplete information. It systematically collects evidence, follows research procedures, reaches in the findings and thereby seeks an answer to the problem.

- It is widely used in collecting and understanding specific information about the behaviour, opinion, values and other social aspects of a particular community, culture or population.
- It is used in collecting, analyzing and interpreting the data of a group, community or culture.
- It helps in understanding the reasons behind the behaviour, experience and attitudes of the people of the group, community, culture or market under study.
- It is authentic because the researcher takes active participation in the activities of the population under study.
- Unlike quantitative research, it does not require a pre-planned framework, objective or interest. The primary interest of the researcher may change based on the nature of the study.

Characteristics of Qualitative Research

- Qualitative Research seeks to explore phenomena using some structured methods such as in-depth interviews, experiences, participant observation.
- It aims to describe differences, explain relationships, describe behaviour, experiences and norms of individuals and groups.
- The questions used for data collection are open-ended ones
- Data is represented in the form of notes, recordings and videotapes.
- The research design allows some flexibility in certain situational aspects. The questions used for the data collection differs individually and depends upon the response of the participants.
- Qualitative research helps in attaining an in-depth knowledge of human nature, attitude, behaviour and experiences.

- It helps in the textual description of the experiences of people.
- It helps in identifying and explaining social norms, religion, roles of gender and socio-economic status.
- It helps in understanding those behavioural phenomena which cannot be quantified.
- It helps in collecting data under more natural situations.
- It helps in determining those factors which are meaningful and are important to the respondents under study.
- The open-ended questions used in qualitative research provide a chance to unfold those facts which cannot be done with the help of 'to the point' close-ended questions.

TYPES OF QUALITATIVE RESEARCH

- The main approaches of qualitative research are:
- Ethnography, Phenomenology, Document or Content Analysis, Case studies, Genetic Studies and Grounded theory
- Based on the purpose of the study Research can be classified into Pure or Fundamental, Applied, Action
- FUNDAMENTAL RESEARCH
- Fundamental Research is basic research which is for the sake of knowledge. Applied research is used to solve an immediate practical problem. Action research seeks an effective way to solve the problem of the concerned area without using a particular methodology/paradigm. The paradigm of research is a way to select, define and solve the problem methodically.
- What is Fundamental Research?
- The Fundamental or Basic Research is also called Pure Research or Theoretical Research. It is always aimed to enrich a theory. It is not concerned with day-to-day affairs. It is concerned with fundamental

problems and vital issues. The result of such a study will be in the form of broad generalizations or theories. Its essential aim is to expand the frontiers of knowledge without considering its practical application.

- Fundamental research is usually carried on in a laboratory environment, sometimes with animals. This type of research, which has no immediate or planned application, may later result in further research of an applied nature. Basic researches involve the development of theory. It most closely resembles the laboratory conditions and controls usually associated with scientific research. It is concerned with establishing general principles of learning. For example, much basic research has been conducted with animals to determine the principles of reinforcement and their effect on learning. Like the experiment of skinner on cats gave the principle of conditioning and reinforcement.
- According to Travers, basic research is designed to add to an organized body of scientific knowledge and does not necessarily produce results of immediate practical value. Basic research is primarily concerned with the formulation of the theory or a contribution to the existing body of knowledge. Its major aim is to obtain and use the empirical data to formulate, expand or evaluate the theory. This type of research draws its pattern and spirit from the physical sciences. It represents a rigorous and structured type of analysis. It employs careful sampling procedures to extend the findings beyond the group or situations and thus develops theories by discovering proved generalizations or principles. The main aim of basic research is the discovery of knowledge solely for the sake of knowledge. Vannevar Bush, in Science the Endless Frontier, says with great authority and validity - Basic research is performed without thought of practical ends. It results in general knowledge and understanding of nature and its laws. The general knowledge provides the means of answering a large number

of important practical problems, though it may not give a complete specific answer to any one of them. It is undertaken out of intellectual curiosity or inquisitiveness. It is not necessarily problem-oriented. It aims at the extension of knowledge. It may lead to either the discovery of a new theory or refinement of an existing theory. The findings of basic research formed the basis for innumerable scientific and technological inventions like a steam engine, the machine, the automobile, computer applications, telecommunications and so on.

Describe the nature of Applied Research

The second type of research which aims to solve an immediate practical problem is referred to as applied research or empirical research. According to Travers, "applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary." It is also called Field research. This type of research helps in solving practical problems. The theories established through basic research on certain samples are applied to other samples. So, it is called -Applied Research'. Most educational research is applied research, for it attempts to develop generalizations about teaching-learning processes and instructional materials. Through applied research, educators are often able to solve their classroom teaching-learning problems. We may depend upon basic research for the discovery of more general laws of learning, but applied research much is conducted in the order to determine how these laws operate in the classroom. It should be pointed out that applied research also uses the scientific method of inquiry. For example, applied research tests the principle of reinforcement to determine their effectiveness in improving learning (e.g. programmed instruction) and behaviour (e.g. behaviour modification). Applied research has most of the characteristics of fundamental research, including the use of sampling techniques and the subsequent inferences about the target

population. Its purpose, however, is improving a product or a process – testing theoretical concepts in actual problem situations. Most educational research is applied research, for it attempts to develop generalizations about teaching-learning processes and instructional materials. It uses theories or findings of fundamental research and formulates new principles. Some of the recent focus of applied educational research have been grading practices, curriculum, content, instructional procedures, educational technology, and assessment of achievement.

Write a short note about Action Research

Research designed to uncover effective ways of dealing with local problems is called action research. This kind of research is not confined to a particular methodology or paradigm. The purpose of action research is to solve classroom problems through the application of scientific methods. Research may be done on a small scale by the teachers to solve their day-to-day problems related to classroom teaching and school activities. The primary goal of action research is the solution to a given problem, and not contributing anything to science. It is similar to applied research in many ways. The study shows that such researches have direct application to real-world problems. Second, elements of both quantitative and qualitative approaches can be found in the study. The purpose of action research is to solve classroom problems through the application of scientific methods. It is concerned with a local problem and is conducted in a local setting. The primary goal of action research is the solution to a given problem, not a contribution to science. The value of action research is confined primarily to those who are conducting it. In the words John Best, action research is focused on immediate applications. Its purposes are to improve school practices and at the same time, to improve those who try to improve the practices, to combine the research processes,

habits of thinking, ability to work harmoniously with others, and professional spirit.

CLASSIFICATION BASED ON METHOD

HISTORICAL RESEARCH

A study of the history of educational developments and changes in their social, political and economic contexts is essential for a better understanding of the educational problems of the present times. Especially about policy making in education, the policy makers and planners should take note of certain historical findings that may guide them to avoid repeating certain policies which might have been found disadvantageous in the past. Interpretation of historical data may help them in developing different hypotheses in the context of the development of educational systems at present and thereby, in identifying directions for suitable interventions in the present educational situations. Furthermore, analysis of the trends of educational developments in their historical context is useful in projecting educational plans with a reasonable probability of success. Historical studies of educational institutions, administration, subject matter, and teaching methods have a direct significance on the work of those involved in curriculum development, actual instruction, day-to-day administration and organisation of educational systems. Moreover, the ideas and practices in the present educational set up have their historical origins. As such, understanding the present situation, practices and ideas require digging into the past.

As specified by Borg and Gall (1983) the subject matter of historical research embraces the following: (i) General educational history. (ii) History of educational legislation. (iii) Historical biography of major contributors in the field of education. (iv) History of the major branches of education, like curriculum, methods and materials, enrolment, staff development, finance and

administration. (v) The institutional history of education like primary education, secondary education, higher education, distance education, non-formal education, adult education, etc. (vi) Cultural history of education concerning the fields of Sociology, Anthropology, Literature and Technology. (vii) History of educational planning and policy formulation. (viii) Historical critics of education.

Main Features of Historical Research

The historical method of research or 'historiography' has certain unique features and is generally counted as one of the methods of scientific inquiry.

1. Historical research aims at developing knowledge of past events within a particular framework of time and social-political, economic and cultural context. A historical researcher attaches importance to the meaning of specific events which have already occurred and explains their causal relationships based on the analysis of the existing data.
2. The researcher digs into the significant data 'that tell us about past events, He /she does not have any control over data since the situations under study do not exist at present. However, every piece of information concerning the past events does not get similar treatment at the hands of the researcher. Only those data which are relevant to the problem under investigation are considered for purposes of analysis.
3. Historical research is conducted based on the analysis of all the known information related to the research problem. It is a fact that the information which existed at the time of the actual occurrence of events does not survive till the data of investigation; hence, only those data which survive and are available till today become the focus of the study. In other words, these existing data are considered to be the population information of the problem. However, the researcher may not have full access to all the data existing at the present moment. Consequently, he/she depends on the total information

available to him/her through all possible efforts. Because of this limitation, the interpretation made about causal relationships of certain events suffers from serious limitations.

4. Data concerning past events are available through different sources. One of the approaches to the classification of historical sources is to treat thein as (i) primary sources, and (ii) secondary sources.

   Primary sources provide first-hand information about past events. Direct observation and reporting or recording of experiences can be treated as the primary source of data. There can be different kinds of primary sources such as :

   - Personal primary sources like a person's direct observation of events in which he /she participated in the past,
   - physical artefacts like collections in museums or evidence of historical spots .in the form of remains or relics, and institutions of various types,
   - mechanical artefacts like films, video films, audio cassettes, and photographs,
   - records were written by actual participants or observers in the form of constitutions, charters, court decisions, official minutes or records, autobiographies, research reports, letters, genealogies, contracts, deeds, wills, permits, licenses, certificates, bills, receipts, magazines or newspaper accounts, maps, pictures, paintings, books, etc.

Secondary sources of data include second-hand information about past events. For instance, the person who supplies information about the past is neither a participant nor an eye witness of events. Items of this type can be in the form of written materials like newspaper articles, interviews referred to in the articles, magazines, books, research reports, etc. It is a fact that secondary sources of data are usually of limited worth because of the errors which result when information is passed on from one person to another.

Usually, primary sources of data are given priority in historical studies to authenticate the presented facts. The second-hand information, which may be found in some distorted form needs to be considered with great care for developing holistic views on the problem. For example, while studying the introduction of mother tongue as a medium of instruction in higher education in India - the primary sources will include Woods Despatch and a report of the Education Commission. The secondary sources will include reports of seminars and speeches of great leaders showing concern about the use of the mother tongue.

The main feature of historical research is the evaluation of historical data. Even when the data are collected through primary sources, doubts can be raised about their validity, reliability and relevance. The process of judging the validity, reliability and relevance of data is called historical criticism. This is undertaken in two stages. The two processes are known as external and internal criticism.

External Criticism: External criticism is concerned with testing the authenticity of the sources of data. In other words, every historical researcher must examine whether a document or source is really what it seems to be. The general criteria followed for such criticism depend on the contemporary reputation of the source and the consistent reputation of the source over the years. This can be traced through a review of the relevant literature. Furthermore, the literary sources can be verified against the authorship of documents by testing signatures, handwriting, scripts, style of writing, language, usage etc. The material sources can be subjected to physical and chemical tests like verification of ink, paint, paper, cloth, stone, metal, wood, etc.

Internal Criticism: Once the sources are verified, the content of the data is subjected to verification which is known as internal criticism of the data. At first, the internal consistency of information presented through a particular source is studied. The more internally consistent a set of information, the more accurate

it can be. In this context, the researcher must find out the literal as well as the real meaning of the content in its appropriate historical context. Then, the external consistency of the data is to be evaluated. Even if the authorship of a report or a document is found accurate, the report or the document may include distorted pictures of the past. For studying the accuracy of the content, usually, two steps are followed by a researcher. One step is to compare the information derived through two independent sources and the other, is to match new information with the information already available in reliable sources.

To check external consistency of the data, Fox (1 969) suggested three major steps: the study should include (i) corroboration of data from two independent sources, (ii) one independent primary source, and (iii) one source reputed for providing contradictory information on any event. It is suggested that in case the researcher finds it difficult to arrive at matching information available in two comparable sources, he/she may apply his/her professional knowledge and judgment to make the final evaluation.

Historical research is "the systematic collection and objective evaluation of data related to past occurrences to test hypotheses concerning causes, effects, or trends of those events which may help to explain present events and anticipate future events" (Gay, 1981, p. 432). According to Isaac and Michael, historical research involves reconstructing "the past systematically and objectively by collecting, evaluating, verifying, and synthesizing evidence to establish facts and reach defensible conclusions, often about particular hypotheses" (1981, p.44).

Historical research is "the process of systematically examining past events to give an account of what has happened in the past" (Johnson, chapter 12, p.1).

True historical research must be distinguished from chronology. Chronology is defined as "simply the setting down of events in the order of their

occurrence, a process similar to the older concept of historical research" (Pothe researcher ll, 1991, p. 137). Chronology of events is merely a first step in the process of historical research, providing data or material for the latter steps.

Purpose of Historical research

Historical research is carried out to serve the following purposes:

1.To reconstruct the past - A historian reconstructs the past objectively and methodically, reaching rebuttable conclusions.

2.To discover unknown events- There are a few historical events about which the researcher have no information. A historian is intrigued by these unrecorded occurrences.

3.To understand the significance of events – To study important historical events to forecast the nation's future success.

4.To find answers to questions about the past - Numerous problems are there in history which needed solutions.

5.To investigate the cause-and-effect - To investigate the cause-and-effect relationship between researcher and events. The past can often help us to get a better perspective about current events. Thus, a researcher aims to identify the relationship between the researcher and the past and the present, whereby; the researcher can get a clear perspective of the present (Mouly, 1978, p.158).

To record and evaluate the accomplishments of individuals, institutions and other kinds of organizations. Historians are keen on documenting and evaluating the accomplishments of prominent individuals and various types of organizations, including institutions and agencies because these entities have an impact on historical events.

It can be performed by anyone, in any type of school or institution

It can help to improve educational practice

It can help education and other professionals to improve their craft

It can help them learn to identify problems systematically

It can build up a small community of research-oriented individuals at the local level

Types of Historical Research

The historical method applies to all fields of study, including science and technology, social sciences, and the humanities, and others. The historical method is applicable in any field where the subject's origins, growth, development, impact, use, theories, personalities, or crisis are investigated.

According to Hillway (1964, p.159), there are six types of historical research as given below:

- Biographical research;
- Histories of institutions and organizations;
- The investigation of sources and influences;
- Editing and translating historical documents;
- Studying history of ideas; and
- Compiling bibliographies.

The type of research to be used will depend on the subject area being studied and the nature of the inquiry being conducted. In practice, historians employ a variety of strategies.

PROCESS OF CONDUCTING RESEARCH

The process of conducting historical research is the same as other kinds of researches.

The process involves the following steps:

1. Identification of research topic/ formulation of the research problem
2. Collection of background information or contextual information about the research topic
3. Formulation of hypothesis(es) (if appropriate) to explain causal relationships between historical events
4. Systematic collection of evidence or data or literature review;
5. Rigorous evaluation of historical resources (the authenticity of the resources and
6. validity of their contents);
7. Interpretation and Synthesis into a narrative account.

1. Identification of Research Topic and Formulation of Research Problem

The first step in historical research is to select a problem falling in the area of the history of education. The researcher may come across several issues of historical significance. Historical studies may be geared towards an assessment of the educational systems at different stages of socio-political development and how the system got modified and changed as per, the requirements of the time. The researcher must first identify (define) a significant historical problem that requires a solution. The researcher can identify an area of knowledge that requires development.

In this context, Borg and Gall (1 983) have suggested five types of topics to be included in the area of historical research in education.

a) Historical studies concerning current social issues such as education of deprived communities, women's education, eradication of illiteracy, etc.

b) Histories of specific individuals, histories of specific educational institutions, and histories of educational movements.

c) Interpretation of ideas or events which had previously seemed unrelated, like linking educational development with the socio-economic development of a region historically.

d) Synthesizing old data with new facts to modify or rewrite history or modify a theory.

e) Reinterpretation of past events that have already been studied, especially, those falling in categories listed under items a) and b) above.

2.Systematic collection of evidence or data or literature review;

After identification of a research topic (defining the topic) and formulation of the problem, examination of the available literature is the next task of the researcher. This step deals with identifying, locating and gathering information regarding the research topic, the kind of data to be gathered, the procedure to follow the researcher and where it is to be gathered, would depend upon the type of topic being investigated.

Even though a lot of information about the past is available in most cases, the researcher is to point out the type of data that are relevant for the study he /she is taking up. The extent to which different types of data (viz. sociological, political, economic, cultural and psychological) concerning the chosen educational problem are relevant is very crucial in the process of one's using the population of information. Based on the description of the required population of data, the historical researcher initially develops an over view of the data and judges whether all relevant information is available or not. Study of related literature and direct scrutiny of information on different sources help the

researcher in such an exercise. Moreover, the researcher makes effort to discover new data in addition to what is available at present.

History is primarily based on the study of written or printed sources, now there is a flood of electronic sources, many of them available on the Internet. These are typically divided into primary, secondary, and tertiary sources. These sources could be published, manuscripts (handwritten), or nonprint materials.

Primary Sources (Primary sources provide raw information and first-hand evidence)

A primary source is a document that contains the original statement on the topic being investigated by the researcher. These contain evidence that is closest to the event under investigation as recounted by observers and participants. Primary sources represent "the data which lie closest to the historical event". They are considered to include the testimony of eye-witnesses or observations made with one or the other senses or by some mechanical device. In most cases, primary sources are the written record of what Historical Research the writer observed or the first-hand expression of his or her thoughts" (Pothe researcher, 1991, p. 139). Thus, it is the direct outcome of the event or the record of eyewitnesses. It bears direct involvement with the event being studied, such as diaries, letters, speeches, and an interview with the person who personally experienced the event, original map, etc. It is not a copy, a repackage or a summary of the original. The basic criteria to identify a particular source as a primary document is, just ask, "Is it a first-hand account?"

These include the following:

Documents generated by the events themselves such as archival records (Governmental, institutional, commercial, ecclesiastical, etc), internal letters and memoranda (memos), speeches, summaries or minutes of conferences and meetings, photographs of people, buildings and equipment, statistical

information (such as tally sheets and surveys), lists of holdings (goods, equipment, etc), and reports and statements (mission statements, employee's guidelines, rules and regulations etc);

- Documents produced to record events immediately such as chronicles, diaries, reports produced by journalists and interviews conducted by them, drawings and photographs, motion picture films, tape recordings and video recordings;
- Documents in supplementary forms produced much later in the form of oral sources, oral traditions and folklore, languages themselves, say fables, folktales, folklore etc are a good source; and
- Artefacts or realia such as inscriptions, seals, coins, medals, drawings, pictures, ruins of monuments

Secondary Sources - (Secondary sources provide second-hand information and commentary from other researchers.)

A secondary source is the one derived or created from a primary source (that first reported the event being studied). It reports events based on the use of primary and other secondary sources as bases of data collection. It contains information reported by a person who did not directly observe the event, object, or condition (Key, 1997, p.1). Thus, these report events by a person other than a direct observer or a participant in the events. These are considered less useful than primary sources. A secondary source may be one or more steps removed from the primary source in terms of time, place or authorship. A source becomes a primary or secondary source depending upon its proximity to the actual event under investigation (Pothe researcher ll, 1991, p.140).

Examples of secondary sources are given are • Textbooks • Encyclopaedias • Monographs

• Articles in magazines.

A copy of an original document is a secondary source as it may not be an authentic one. In copying from the original document, certain errors or omissions can occur intentionally or unintentionally. The original might get modified at the stage of copying through editing or interpretation.

Tertiary Sources - These sources include bibliographies, catalogues and indexes that guide a researcher to primary and secondary sources.

3. Formulation of Hypothesis(es)

In the study of a historical event, there may be many questions that may arise about it, to which the researcher would like to find the answer. The use of hypotheses serves useful purposes as given below:

It increases the objectivity of the investigation.

• It minimizes researcher bias.

• A historian often would have access to a large amount of data that may prove to be difficult to handle unless he can decide which is relevant or which is not relevant to his research. Hypotheses provide him guidelines for deciding which data is relevant or not at each stage of collection, analysis and interpretation of data. Thus, one can evolve strategies to collect data.

• It provides him with a basis to identify various factors about one another and also to synthesize them into generalizations or conclusions (Mouly, 1978, p.160).

• It serves a useful purpose as an aid to conducting rigorous studies

4. Systematic Collection of Evidence or Data or Literature Review

To produce a work of history, a historian undertakes steps consisting of selection, evaluation, interpretation and synthesis of data into a narrative

exposition. Here the researcher is concerned with the collection of evidence or data. The gathering of primary-source (first hand) evidence is the most difficult task. The selection of sources is an essential step, especially for recent history. Selection is done taking into consideration, "the nature of the researcher's particular problem and the criteria of relevance and significance that drive from his hypotheses. Selection is facilitated by the use of bibliographic aids and existing secondary works but the historian of a recent topic must nevertheless be prepared to sift and digest masses of material, most of which will not directly appear in the final work" (Daniels, 1996, p. 228).

Rigorous Evaluation of Historical Sources

Having collected sufficient authentic data, the researcher prepares a draft outline of the report. At this stage, the researcher organises data under different headings and tries to depict a holistic picture of the problem. This phase enables the researcher to scrutinise the data in hand to see if the data collected are enough for the study or if there is a need for more.

A historian's data is frequently referred to as evidence. Historical research is always based on evidence from the past. It is intricate in nature and typically abundant in quantity. A historian spends a great deal of time sifting through pertinent evidence. He narrows it down, selecting it with care. Frequently, the evidence throws up surprises at each stage of the sifting process. The quality of historical sources, particularly those on the Internet, varies significantly. Each source of information must be evaluated for authenticity and accuracy before being used as evidence, as these are influenced by a variety of factors such as the researcher's economic, political, ethical, and social environment, as well as personal preferences and prejudices. Generally, published sources such as books and periodicals are filtered. Peer review and editing may be required. The majority of information accessible via the Internet is unfiltered. This is dangerous. The question then becomes whether the information source he is utilising is

appropriate for his research. Before utilising sources, he must evaluate them regardless of whether they are Internet-based or not. A researcher would like to know if the sources being used by him are:

• Relevant to his research (that is appropriate for his research work),

• Worthwhile (substantial enough to serve his purpose), and

• Competent (genuine, accurate and trustworthy).

A researcher can follow these approaches

For evaluation, one may use the following criteria:

• Authority, • Scope, • Up-to-datedness, • Reliability, and • Objectivity.

Authority

- Who is the author or developer of the source? What are his qualifications and experience in the field concerned?
- Who is the publisher or producer of the site? What is his reputation?
- Find out how the information has been documented, giving footnotes and/or a
- bibliography? Examine the documentation, to determine the quality of sources covered.

Scope

What topics have been covered? What is the extent of coverage of topics (in-depth or

broadly)?

Up-to-datedness

How up to date is the content of the source? Has the date of publication been given

clearly?

In the case of an Internet source, it may indicate, the date of writing or when it was updated

last or when the database was activated.

Reliability

How far information is reliable and free from errors? Internet sources are not usually

verified by editors or evaluated by referees. Thus, there is a great possibility of

inaccuracies taking place.

Objectivity

Find out, if there is bias in the presentation of information? Is there an attempt to influence? the opinion of the readers towards a certain ideology or school of thought?

5. Conclusion (Data Interpretation and Synthesis into a Narrative Account)

A researcher must consult a variety of sources, including traditional printed and electronic sources. Data synthesis includes selecting, organising, and analysing the data in terms of topical themes and central ideas or concepts. Then, these themes and central ideas are put to a good historian makes an effort to:

- give the most meaningful representation of reality,
- fill up gaps wherever those exist, giving necessary explanations,
- reconcile inconsistencies in the data,

- carefully conjure up an intelligent guess, where facts are lacking but admits honestly that he is using an intelligent and educated guess, and
- provide footnotes and bibliography, citing sources and scholarly authorities, used by him to arrive at the conclusions. either to form a narrative account that is contiguous and meaningful whole.\]

Advantages of Historical Research

There are some advantages of historical research as given below:

- The research is not physically involved in the situation understudy
- No danger of experimenter-subject interaction; Documents are located by the researcher, data is gathered, and conclusions are drawn out of sight (Key, 1997, p.2-3);
- "Historical method is much more synthetic and eclectic in its approach than other research methods, using concepts and conclusions from many other disciplines to explore the historical record and to test the conclusions arrived at by other methodologies" (Shiflett, 1984, p. 385).

Limitations of Historical Research

The human past is the subject matter of historical research. It is to be noted that the past can only be known through the relics that become available to the researcher. Thus, the past can no longer be examined directly by him. A researcher cannot re-enact the past but can only interpret it, unlike experimental research. "Since history contains an inherent element of subjectivity, the final truth on any important subject can never be written. Later historians will work with different frames of reference, new interests, and new conjectures. They will ask new questions and often discover new source material. Finally, because of the defects of the sources themselves, the total truth of an important event can never be completely established. New generations and other nationalities will always be ready to offer new insights and new interpretations of Historical

Research the past" (Daniels, 1996, p. 229). In the ultimate analysis, one may conclude that there is no possibility of the final truth to be written.

Experimental Research Designs

What is experimental research design?

Research design is a master plan in the hands of a researcher. It contains the methods and procedures for collecting and analyzing the research study. The research design is the overall plan for how to obtain answers to the question being studied and how to handle some of the difficulties encountered during the research process. In experimental research, the researcher selects the participants and divides them into two or more groups having similar characteristics and applies treatment to one group and measure the effect upon groups.

The experimental research method is commonly used in sciences such as psychology, physics, chemistry, biology and medicine etc. It is a collection of research designs which use manipulation and controlled testing to understand causal processes. Generally, one or more variables are manipulated to determine their effect on a dependent variable. In this method, the researcher makes changes in the independent variable and studies their effects on dependent variables under controlled conditions. According to Riely, experimental design is a powerful design for testing hypotheses of causal relationship among variables.

Characteristics of experimental research

- Experimental research is defined as "observations under controlled conditions".
- In this study, the researcher is an active agent rather than a passive observer.

- Experimental designs are concerned with the examination of the effect of an independent variable on the dependent variable, where the independent variable is manipulated through treatment or intervention(s).
- The researcher manipulates the independent variable
- The researcher decides the nature and extent of the treatment
- After the treatment, the researcher observes the effects of the treatment.
- Experimental research enables the researcher to go beyond description and prediction and measure the effects.
- True experimental designs consist of three cardinal features: randomization, control & manipulation or trial.
- Manipulation refers to conscious control of the independent variable by the researcher through treatment or intervention to observe its effect on the dependent variable.
- Control refers to the use of a control group and controlling the effects of extraneous variables on the dependent variable.
- Matching - It is a weak but a common method of control over the extraneous variables. In matching the researcher identifies one or more extraneous variables to be controlled which are supposed to affect the dependent variable.

Classification of Experimental Research

Experimental research design is further classified as

- True experimental design,
- Quasi-experimental design
- Pre experimental design

True experimental designs

In true experimental designs, the researchers have complete control over the extraneous variables and can predict confidently that the observed effect on

the dependent variable is only due to the manipulation of an independent variable.

Advantages of true experimental design

- Most powerful design to establish the causal relationship between the independent and dependent variable.
- The study is conducted under a controlled environment. So a greater degree of purity is possible in observation.
- Conditions that are not found in a natural setting can be created in an experimental setting in a short period.
- The experiment is carried out in an experimental setting. So the problems of real-life situations and the personal problems of the researcher are eliminated.
- The researcher can manipulate independent variables to easily determine the cause and effect relationship.
- Due to the control set up by experimenter and the strict conditions, better results can be achieved.

Disadvantages of true experimental design

- The experimental study cannot be replicated due to ethical or practical reasons.
- Many of the human variables neither have valid measurable criteria nor instruments to measure them.
- In experimental studies conducted in natural settings like a school, hospital or community, it is not possible to impose control over extraneous variables.
- Experiments are often more impractical.
- It is very difficult to obtain permission from the participants.
- Because the size of the sample is kept small, the representativeness of the findings of such study is questionable.

Steps in Scientific Research

Step 1: State the research problem

Identification of the research problem.

Here the researcher attempts to know whether the particular problem is suited to experimental study or not

Step 2: formation of hypothesis

The researcher forms a reasonable hypothesis to test cause-effect relationships

Step 3: Develop a standardized procedure

This involves setting up the experimental and control conditions.

Step 4: Identify the population, select the participants and assign them to conditions

This involves identifying the type of people and ensuring that the participants are representative of the population.

Step 5: Treatment

Here the researcher observes and manipulates the group to see change

Step 6 Apply statistical techniques to the data

This involves using statistics to describe the meaningful patterns of data

Step 6: Conclude from the data

This involves evaluating, whether or not the data supports the research hypothesis, clearly staying the practical uses of the results, theoretical implications, and suggesting future studies to address the limitations of the study.

Experimental research includes –

1. Pre-test/post-test control group design
2. Solomon four-group design
3. Two groups of random sample design
4. Matching sample design
5. Factorial designs

Pre-test/post-test control group design

In experimental designs, pre-test- post-test designs are the preferred method to compare participant groups and measure the degree of change occurring as a result of treatments or interventions. It is a measurement of the learning received during the class (period/time) as a result of comparing what the student knew before in a pre-test and after the class experience in a post-test. This study is generally significant than all other study designs. Because it generally produces the most accurate results in comparison to all other study designs. Experimental designs consist of two main types of study participants – an experimental or treatment group and a comparison or control group.

Experimental or treatment group

An experimental (treatment group) is a group of participants to whom an intervention is delivered and whose outcome measures are compared with those of the control group.

The control group (comparison group)

A control group refers to a group of "untreated" study participants (people who do not receive the intervention) that are generally similar to the treatment group in all other respects except for the fact that they do not receive the intervention.

This study has two important component – a pre-test and a post-test.

Pre-test-

It aims to quantify the knowledge attained by the students in the class with traditional learning style and educational backgrounds. Pre-tests help to measure true learning. By comparing pre- and post-tests, teachers can see what students learned from the lessons that were developed. Pre-tests can give students a preview of what will be expected of them.

Pre-tests can help generate ideas for preparing post-tests.

Reasons for using a pre-test:

- To measure a starting point or the amount of pre-existing knowledge
- To compare with the starting point of a post-test
- To measure the learning level students.

Control group can be made up of the same group of the pupil or other units with identical composition. This avoids bias and is particularly important for behaviour-related studies. Reasons for using a post-test:

- To measure the learning as a result of the experiment
- To analyses the appropriateness of the learning objectives
- To recognize students who need additional help
- To target any instructional needs to improve the course

For many true experimental designs, pre-test-post-test designs are the preferred method to compare participant groups and measure the degree of change occurring as a result of treatments or interventions.

Solomon Four Group Design

In this experiment, the investigator randomly divides the sample into four separate groups- two experimental groups and two control groups. The first experimental group would receive the same procedure as in the pre-test /post-test design -that is random selection, pre-test, treatment and post-test. The first

of the Treatment group is given the pre-test, no treatment and then the post-test. The second experimental group should not be given pre-test but given treatment and post-test. The second treatment group nothing is to be given until the post-test.

Experimental Group 1	Pre-test	Treatment	Post -test
Treatment Group - 1	Pre-test	---------	Post- test
Experimental Group 2	----------	Treatment	Post-test
Treatment Group - 2	----------	----------	Post -test

Two Group Random sample design

In this design, the experimenter may choose to use only the last two groups of the Solomon four-group design. Here the Experimental group is given treatment and post-tested without conducting pre-test. The Treatment group is given only post-test.

Experimental Group	----------	Treatment	Post -test
Treatment Group	----------	----------	Post -test

The matching samples design/matched pairs design

It is more vigorous than other experimental researches. In this design, the researcher attempts to match or pair characteristics/ traits of control and

experimental groups. For example, a study to compare the effectiveness two methods of teaching. The researchers want to compare two methods, the current method and a modern method. They select two groups of children and match pairs of children across the two groups according to writing ability, marks in the last exam, reading comprehension and efficiency.

Writing ability			
Experimental Group	Pre-test	Treatment	Post -test
Treatment Group	Pre-test	----------	Post -test

Marks in the last exam			
Experimental Group	Pre-test	Treatment	Post -test
Treatment Group	Pre-test	----------	Post -test

Reading comprehension			
Experimental Group	Pre-test	Treatment	Post -test
Treatment Group	Pre-test	----------	Post -test

Efficiency			
Experimental Group	Pre-test	Treatment	Post -test

Treatment Group	Pre-test	----------	Post -test

Factorial Design

In this research design, there are two or more independent variables are manipulated to study the observed results. Each independent variable is treated as a factor and study each factor. A factorial design is often used by scientists to understand the effect of two or more independent variables upon a single dependent variable or more. In this study, independent variables are called factors. When multiple independent variables are there in a single study, it is called factorial design.

Example – "A study on computer use as an instrumental tool to improve the maths performance". In this study the researcher design a 2x2 factorial design. A 2x2 factorial design has two factors (IV) and two levels. Here one factor is Method of Instruction is one factor (IV) and the two levels are No computer Use and Computer Use. Gender is another factor (IV) and Boys and Girls are two levels.

WHAT IS CASE STUDY?

The case study method is a qualitative research method involving an in-depth and detailed examination of a particular case. According to Gustafsson 'Case studies are based on an in-depth investigation of a single individual, group or event to explore the causes of underlying principles." This method is extensively used in sociology, education, political science, public administration, management and psychology.

Characteristics of Case study

Some of the very important characteristics of the case study method are listed below:

- The case study is a deep, detailed and intensive study of a problem
- It is one of the methods of qualitative analysis
- It is a comprehensive study method
- In this study, all the variables of a problem are considered or studied

Steps of Case Study

The case study includes the following steps:

Selection of a case for investigation

- The first step in any case study is the identification and selection of a case for investigation. At this stage, the researcher realises the nature of the case. Keeping in view different aspects of the case the researcher delimits what is to be studied within the scope of the investigation.
- After identification of the case and delimitation of the case, the researcher starts for the study. The mechanisms to be chosen may be observation, interviews, document surveys, audio-visual recordings, projective and non-projective tests, etc. The observation can be a participant in nature as employed in ethnography. It can be direct observation. Data may be gathered through various sources like gathering evidence from participants, functionaries and stakeholders of a programme, institutional records and documents, observation of events taking place etc.
- Data gathered through multiple sources are subject to qualitative analysis. It can be a holistic analysis of the entire case or analysis of a specific aspect of a case.
- Data analysis involves surveyprocedures. The researcher interprets the background followed by the narration of events chronologically.
- In the next step, the researcher reports his experiences and findings of the case.

- Instituting remedial action – At last, the researcher reports some corrective or improvement programmes

Conclusion

Different research methods have their uniqueness about the focus of studies. Biography is used to explore the life of an individual whereas Phenomenological Inquiry is used to understand the essence of experiences of persons about a phenomenon. Grounded theory approach is adopted to develop a theory grounded in data from the field. Ethnography aims at describing and interpreting a cultural and social group. The case study is used to develop an in-depth analysis of a single case or multiple cases. However, all these methods adopt qualitative techniques of data collection, such as interviews, observation, the study of documents, relevant records, etc and incorporate survey and narrative approaches of data analysis.

WHAT IS DESCRIPTIVE SURVEY RESEARCH

Survey research is defined as a research method that describes the characteristics of the population that is being studied. The survey research method is used for collecting primary data from a representative sample of individuals or respondents of the target population. In survey research, the researcher collects data directly from the sample/population usually by questionnaire or interview. When the sample / population responded to a survey the responses are known as self-reports. In Survey research, the researcher uses demographic variables (demographic variables such as occupation, age, religion, nationality, gender, income, race, family size and education).

Demographic variable includes personal statistics such as income level, gender, marital status, educational level, location, ethnicity, race, and family size.

Steps in Survey research

1. Statement of the problem

An adequate statement of the research problem is one of the most important parts of the research. There are at least three criteria for a good problem and problem statement. Firstly, the problem should express the relation between two or more variables. Secondly, the problem should be stated clearly and unambiguously in question form. Thirdly, the problem and the problem statement should have possibilities for empirical testing.

2. Sample and the Sampling Plan:

Selecting the universe in the field of study and choosing the sample from the universe is the second crucial steps in survey research. The universe to be sampled and studied must be defined. In sampling, normally the researcher collects limited data and after studying the limited data tries to infer certain conclusions about the characteristics of the population. Therefore, the sample design must be a true representative sample. The sample must be free from sampling error

3. Development of Instruments for Data Collection:

Kerlinger (1973) classified the methods of data collection in survey research as follows (i) Personal interview; (ii) mail questionnaire; (iii) Panel (iv) Telephone and (v) Observations. Among these, a personal interview and mail questionnaire are considered to be the most popular methods. Interview schedules and questionnaire methods are often used for data collection.

4. Grouping and Tabulation of Data:

It is difficult to study or interpret large data without grouping it, even if it is arranged sequentially. For this, the data are usually organized into groups

called classes and presented in a table which gives the frequency in each group. Such a frequency table gives a better overall view of the distribution of data and enables the researcher to rapidly comprehend the important characteristics of the data.

5. Analysis of Data

For analysis of data, both quantitative and non-quantitative methods are used. The objectives of analysis are

(i) To characterize what is typical in a group

(ii) To indicate how widely individuals in the group vary

(iii) To know how the individuals are distributed concerning the variable being measured

(iv) To show the relation of the variables in the data to one another

(v) To describe the difference between two or more groups.

Further, analysis can help in categorizing, ordering, manipulating and summarizing data to obtain answers to research questions. It also helps reducing data to intelligible and interpretable form so that the relations of the research problem can be studied and tested. Analysis, particularly in case of survey or experimental data, involves estimating the values of unknown parameters of the population and testing of hypotheses for drawing inferences.

Characteristics of Survey research

- Survey research is a quantitative research method
- It attempts to collect quantifiable(calculatable) information for statistical analysis.
- It uses subjects like individuals, groups, organizations or communities.
- Sample selection must be done without any prejudice or preference
- Data collected through the survey will represent the entire population.
- The primary way of collecting information is by asking people structured and predefined questions.

- Interviews or questionnaires are the common methods used for data collection.
- In survey research, none of the variables are influenced in any way. This uses observational methods to conduct the research. Hence, the nature of the variables or their behaviour is not in the hands of the researcher.
- Survey research is generally a cross-sectional study where different sections belonging to the same group are studied.

Advantages of Survey Research

- The faster data collection is possible than other methods
- Relatively inexpensive for data collection
- Survey data can be very accurate if sampling is probabilistic
- Access to a wide range of participants
- It can be administered remotely via online, mobile devices, mail, email, or telephone.

Disadvantages of Survey Research

- Data may be superficial (insincere/shallow/artificial).
- Respondents often may not provide accurate and honest answers
- Respondents may not be fully aware of the reasons for any given answer because of lack of memory on the subject, or even boredom.
- Surveys with closed-ended questions may have a lower validity rate than other question types.
- Data errors due to non-responses may exist.

EX-POST FACTO RESEARCH

On basis of the occurring events, there can be two designs or forms of research and these are Prospective research design and Retrospective research design. When the researcher tries to find out the future or potential results that is, the effect after treating the independent variable or the cause, then the

researcher is trying to examine the prospective or the future results. For example, if the researcher wants to examine the effects of excess smoking, then the subject may be asked to smoke under varied conditions which may result in cancer. The Retrospective research design on the other hand is one in which the researcher tries to trace the history to find out the basic reason behind an event. Here a result has already occurred, and the researcher is trying to find out the causes behind its occurrence by going backwards in history. This kind of results obtained is said to be based on retrospective research design. For example, if the researcher wants to examine the reason behind the occurrence of cancer in a person, then they may try to trace the possible reasons that might have led to cancer. The possibilities may be excess of smoking/ heredity/ diet habits and so on.

Ex-post facto research is a kind of research in which the researcher predicts the possible causes behind an effect that has already occurred. For example, if a child is delinquent (that is, one who indulges in criminal activities), then to find the basic reason behind such delinquency, the researcher would try to find out the various events that have occurred and the many possibilities that could have contributed to the concerned delinquent behaviour. The expected possibilities may be lack discipline at school/ family history/ peer effect/ neighbourhood or socialisation. It is an interesting point to note that, the researcher predicts a cause based on a controlled effect (since no variation can be done on the effect which has already taken place based on the independent variable or the cause). Thus, ex-post-facto research can be defined as an empirically based investigation that does not involve the researchers' direct control over the independent variables because they have already led to effects which can no Ex-Post Facto Research more be manipulated. The conclusions regarding the relationship between the variables are inferred without intervening or varying the independent or dependent variable. The term ex-post-facto according to Landman (1988: 62) is used to refer to an experiment in which a researcher, instead of finding a

treatment, examines the effect of a naturally occurring treatment after it has occurred. In other words, it is a study that attempts to discover the pre-existing causal conditions between groups. It should, however, be pointed out that the most dangerous of ex-post factor search is the conclusion that because two factors go together, one is the cause and the other is the effect.

Characteristics of Ex Post Facto Research

Based on the concept of the ex-post factor research, it is also known as 'causal-comparative research'. The ex-post facto research has a certain characteristic that distinguishes it from other different types of researches. Some of these characteristics are presented below in the following paragraphs.

1. The research possess a Control Group

As the research is done on basis of the study of the cause which has already led to its effects, it becomes necessary for the researcher to keep a control group, which can be used for comparison with the actual experimental group, later on, to analyse the cause of an already occurred event.

2.The behaviour, action, event or the treatment or the independent variable of the research cannot be manipulated or changed

As ex-post research is a kind of study which tries to predict the causes based on actions that have already occurred, the researcher cannot manipulate or change the already occurred actions or behaviour.

3.The research focuses on the effects

Since the researcher tries to analyse and predict the reasons behind the occurrence of an event or phenomena, their first attempt is to focus on the event or the phenomena that have already occurred. Only after having a detailed study

of the phenomena or the event, the researcher tries to determine the causes behind such an event or phenomena.

4.The research tries to analyse the 'how' and 'what' aspect of an event

Since the researcher tries to understand the causal effects behind a phenomenon, the research focuses on how and what reasons have led that phenomena to occur.

Essentials/ Requisites for Inferring Causal Relationships

To infer or conclude the cause-and-effect relationships, the researcher needs to take care of the following aspects:

1.Associative variation

To infer/ predict or conclude that a particular effect 'y' is a result of a cause 'X, there should be an association between them. Therefore, the researcher can conclude only after examining that a variation in 'x ' yields the effect 'y'.

2.Absence of other causes

The researcher should analyse each aspect of the causal relationship with full detail and find out the best possible cause/ reason or independent variable that has ultimately led to the effect /action or event to occur. For example, cancer can be due to several factors. In ex-post-facto research, the researcher finds out the best possible reason that might have led to the occurrence of that disease within the person or the subject.

Steps of Ex-Post Facto Research

The process of ex-post-facto research is systematic and follows a definite sequence. As mentioned by Isaac and Michael (1971), the following are the steps involved in the ex-post facto research—

Step 1. Determining the problem

In ex-post-facto research, the researcher must focus on the problem that he or she needs to study. They not only need to find out a problem, but they also need to determine, analyse and define the problem which they will be dealing with.

Step 2. Literature Review

Before trying to predict the causal relationships, the researcher needs to study all the related or similar literature and relevant studies, which may help in further analysis, prediction and conclusion of the causal relationship between the variables under study. Step

3. Formulation of hypothesis

The third step of the ex-post facto research is to propose the possible solutions or alternatives that might have led to the effect. They need to list out the assumptions which will be the basis of the hypothesis and procedure of the research.

Step 4. Designing the approach

Once the problem has been defined and the hypothesis has been postulated, the researcher needs to select the sample which fits the criteria of the study. They also need to select the scale or construct an instrument for collecting the required information/data. Once the designs are all finalised, the researcher analyses the relationship between the variables.

Step 5. Validity of the research

The researcher needs to validate the significance of their research. They need to be cautious regarding the extent to which their findings would be valid and

significant and helpful in interpreting and drawing inferences from the obtained results.

Step 6. Interpretation of the conclusion

Finally, the researcher needs to analyse, evaluate and interpret the information collected. It is on basis of this step only; the researcher selects the best possible alternative of causes that might have led the effect to occur. Similarly, Jacobs et al. (1992: 81) also proposed that the following steps are involved in conducting an ex-post facto-research:

1st Step: The first step should be to state the problem.

2nd Step: Following this is the determination of the group to be investigated. Two groups of the population that differ about the variable, should be selected proportionally for the test sample.

3rd step: The next step refers to the process of collection of data. Techniques like questionnaires, interviews, literature search etc. are used to collect the relevant information.

4th Step: The last step is the interpretation of the findings and the results. Based on the conclusions the hypothesis is either accepted or rejected.

It must be remembered that even though the ex-post facto research is a valid method for collecting information regarding an event that had already occurred, this type of research has shortcomings and that only partial control is possible.

Strengths and Weaknesses of Ex-Post Facto Research

No research can be perfect in itself. All methods have their strengths as well as weaknesses. The same is applicable in the case of ex-post factor research too.

The strengths of the ex-post facto research are:

It is considered a very relevant method in those behavioural researches where the variables cannot be manipulated or altered.

The examples of such researches can include many sociological (e.g. delinquency) as well as educational variables (e.g. achievements).

It is more useful than experimental research as it can be used in analysing a cause on basis of the effect, which is impossible in experimental research.

It is less time consuming as well as economical.

It gives a chance for the researcher to analyse on basis of his personal opinion and then come out with the best possible conclusion.

The weaknesses, as well as the limitations of the ex-post facto research, are:

As discussed earlier, in ex-post facto research, the researcher cannot manipulate the independent variables.

The researcher cannot randomly assign the subjects to different groups.

The researcher may not be able to provide a reasonable explanation for the relationship between the independent and dependent variables understudy

CONCEPT OF POST HOC FALLACY

While predicting the causal relationships between the variables, the researcher falls prey to the bias called the post hoc fallacy. The concept of post hoc fallacy says that human tends to arrive at conclusions or predictions when two factors go together, one is the cause and the other is the effect. Because delinquency and parenthood go together, we may conclude that delinquency is the effect and parenthood is the cause, whereas, in reality, the peer group to which the child belongs may be the actual reason.

UNIT - 3: FORMULATING HYPOTHESIS

Meaning, Types, uses, Forms of hypothesis, Criteria for a hypothesis, Methods of deriving hypothesis, Testing of hypothesis, Basic concepts in testing the hypothesis: Null hypothesis and Alternative hypothesis, Level of significance, Decision Rule, Type I and Type II Errors, Two -tailed and One-tailed tests – Procedure for hypothesis testing – Distinguish among Purpose statements, Research questions, Hypothesis and Objectives.

What is Hypothesis?

Hypothesis is usually considered as the principal instrument in research. The derivation of a suitable hypothesis goes hand in hand with the selection of a research problem. A hypothesis, as a tentative hunch, explains the situation under observation to design the study to prove or disprove it. What a researcher is looking for is a working or positive hypothesis. It is very difficult, laborious and time-consuming to make adequate discriminations in the complex interplay of facts without hypothesis. It gives a definite point and direction to the study, prevents blind search and indiscriminate gathering of data and helps to delimit the field of inquiry.

Describe the concept of hypothesis

The hypothesis is the most important mental tool used in research. In research, after defining the problem, the next task of the researcher is to formulate a tentative explanation of that problem in the form of proposition. This tentative explanation, the validity of which is still to be tested is called the hypothesis. A hypothesis is a tentative statement about the relationship between two or more variables. A hypothesis is a specific, testable prediction about what you expect to happen in your study. A hypothesis is an assumption statement about the relationship between two or more variables

that suggest an answer to the research question. It is a tentative prediction or explanation of the relationship between two variables.

Hypothesis translates the problem statement into a precise, unambiguous prediction of expected outcomes. In other words, the hypothesis converts the question posed by the research problem into a declarative statement that predicts an expected outcome. It is an important and integral component of the modern scientific approach. A hypothesis is a tentative assumption drawn from practical knowledge or theory.

Formulation of hypothesis

The formulation of the hypothesis is an important step in the process of formulation of the research problem. Keen observation, creative thinking, guess, imagination, vision, insight and sound judgment are of greater importance in setting up the reasonable hypothesis. A thorough knowledge about the phenomenon and related fields is of great value in its process. The formulation of hypothesis plays an important part in the growth of knowledge in every science. However, the formulation of the hypothesis is one of the most difficult steps in the entire scientific research process. A good problem may make the formation of hypothesis easier. For formulating a hypothesis, variables play an important role. At first, to formulate a hypothesis, the researcher must clearly define the variables.

Meaning of Hypothesis

The hypothesis is usually considered as the principal instrument in research. The word hypothesis (plural is hypotheses) is derived from the Greek word – 'hypotithenai' meaning 'to put under' or 'to suppose' Etymologically hypothesis is made up of two words, "hypo" (less than) and "thesis", which mean less than or less certain than a thesis. The hypothesis is a tentative proposition formulated for empirical testing. It is a declarative

statement combining concepts. It is a tentative answer to a research question. It is tentative because its veracity can be evaluated only after it has been tested empirically. Lundberg defines, "a tentative generalization, the validity of which remains to be tested." Goode and Hatt define it as "a proposition which can be put to a test to determine its validity." Hypotheses are indeed useful and they guide the research process in the proper direction.

A hypothesis is a prediction (FN Kerlinger). It says that if 'X' occurs, 'Y' will also occur i.e., 'Y' is predicted from 'X'. If this 'X' is made to occur (vary) and it is observed that 'Y' also occurs (varies concomitantly) then the hypothesis is confirmed. It should, however, be remembered that the formulation of hypothesis, though advisable, is not necessary for all types of studies, it is least crucial where the study is exploratory. But it is a must where the study is experimental.

What are the sources of Hypothesis?

> A *hypothesis* is an assumption, something proposed for the sake of argument so that it can be tested to see if it might be true.

The derivation of a good hypothesis demands characteristic of experience and creativity. A good hypothesis can come only from experience. Some degree of data gathering, the review of related literature, or a pilot study must precede the development and gradual refinement of the hypothesis. A good investigator must have not only an alert mind capable of deriving relevant hypothesis but also a critical mind capable of rejecting the faulty hypothesis.

Hypotheses can be derived from various sources:

Theory: This is one of the main sources of hypotheses. It gives direction to research by stating what is known. The logical deduction from theory leads to new hypotheses.

Example

Theory - Immune system -The immune system is a host defence system comprising many biological structures and processes within an organism that protects against disease. The main persecutor in charge of controlling COVID- 19 is the immune system.

Hypothesis:

- The immune system is closely related to COVID- 19 disease
- The immune system has no close relationship with COVID- 19 disease
- Is there any relationship between the Immune system and COVID- 19 diseases?

Observation: Hypotheses can be derived from observation. For example, from the observation of price behaviour in a market, the relationship between the price and demand for an article is hypothesized.

Analogy: Review of similar studies in the area or studies on similar problems is useful for forming a hypothesis. Examination of data and records, concerning the problem for possible trends, peculiarities and other clues are also a useful source of hypothesis.

Intuition and personal experience: These may also contribute to the formulation of hypotheses. Personal life and experiences of persons determine their perception and conception. Discussions with colleagues and experts about the problem may help to form a hypothesis.

Findings of studies: Hypotheses may be developed out of the findings of other studies to replicate and test.

Culture: India has a rich cultural heritage. India is a land of great ideas, theories, tentative theories and provisional prepositions. Such ideas and theories may contribute to problem forming and creation of useful hypothesis.

Continuity of research: The continuity of research in a field itself constitutes an important source of hypotheses.

Personal experience: All true knowledge beings with experience. Personal experience is another source of hypotheses. Prior experience in research findings is perhaps the most common source of new research hypotheses.

Classification of hypotheses

What is Research hypothesis?

If a hypothesized relationship is to be tested by scientific methods, it is termed as a research hypothesis. The research hypothesis is a predictive statement that also states the relationship between an independent variable and a dependent variable. Usually, a research hypothesis must contain, at least, one independent and one dependent variable. The research hypothesis is also known as a scientific or workable hypothesis. Research hypotheses are classified as being directional or non-directional.

What is Directional Hypothesis?

A directional hypothesis is one that specifies the expected direction of the relationship between the independent and dependent variable. For example, the hypothesis: "Adolescent boys with high IQ will exhibit low anxiety than adolescent boys with low IQ" is a directional research hypothesis because it stipulates the direction of the difference between them.

Non- directional Hypothesis

A research hypothesis which does not specify the direction of expected differences or relationships is termed as a non-directional research hypothesis. For example, the hypotheses: "There is a difference in the anxiety level of adolescent girls of high IQ and low IQ". Non-directional hypothesis indicated the existence of a relationship between variable. It does not specify the anticipated direction of the relationship. Another example: "There is a difference in the anxiety level of adolescent girls of high IQ and low IQ"

A. Statistical hypothesis

After the data collection, it is time to test whether the data support or refute the **research hypothesis**. For this, it needs to be translated into a statistical hypothesis. A statistical hypothesis is given in statistical terms. A statistical hypothesis is also known as the **null hypothesis** which states that there is no relationship between the independent variables and dependent variables. These are hypothetical statements denying what is explicitly indicated in the **working hypothesis**.

They state that no difference exists between the parameter and the statistic being compared to it.

For example, the hypothesis is that "The family income and expenditure are strongly correlated". The Null Hypothesis may state that "there is no relationship between family income and expenditure". The Null Hypothesis is formulated for testing statistical significance. "The *mean* reading achievement of the population of Third-grade students taught by Method A equals the *mean* reading achievement of the population taught by Method B." This is a convenient approach to statistical analysis. As the test would nullify the null hypothesis they are so-called. If in the data analysis a

statistically significant relationship emerges between the variable at a specified level of significance, the null hypostasis is rejected.

What are the characteristics of a good hypothesis?

An acceptable hypothesis should fulfil conditions as given below:

1. Conceptual clarity: A hypothesis should be conceptually clear. It should consist of clearly defined and understandable concepts. Clarity is obtained using defining operationally the concepts in the hypothesis.

2. Specificity: *A* hypothesis should be specific and explain the expected relations between variables and the conditions under which these relations will hold.

3. Testability: *A* hypothesis should be testable and should not be a moral judgement. It should be possible to collect *empirical evidence* to test the hypothesis.

4. Availability of techniques: Hypotheses should be related to available techniques. Otherwise, they will not be researchable; therefore, the researcher must make sure that methods are available for testing his proposed hypotheses.

5. Theoretical relevance: *A* hypothesis should be related to a body of theory. When research is systematically based upon a body of existing theory, a genuine contribution to knowledge is more likely to result. Therefore, a hypothesis should possess theoretical relevance.

6. Consistency: Hypotheses should be logically consistent. Two or more propositions logically derived from the same theory must not mutually contradictory.

7. Objectivity: Scientific hypotheses should be free from value - judgement. In principle, the researcher's system of values has no place in

the scientific method. However, as social phenomena are affected by the milieu in which they take place, the researcher must be aware of his values and state them explicitly.

8. Simplicity*: A* hypothesis should be a simple one requiring fewer conditions or assumptions. The hypothesis should state the relationship between variables.

What is a Descriptive Hypothesis?

Descriptive Hypotheses are propositions that describe the characteristics (such as size, a form of distribution) of a variable. The variable may be an object, person, organization, situation or event. Some examples are:

"Patient who attends pre-operative education classes less post-operative emotional stress than have a patient who does not."

What is a Relational hypothesis?

These are propositions, which describe the relationship between two variables. *The relationship* suggested may be a positive *or negative correlation or causal* relationship.

For example: "Families with higher incomes spend more for recreation."

What is a causal Hypothesis?

Causal Hypothesis state that the existence of, or a change in, one variable causes or leads to an effect on another variable. e.g., smoking causes lung cancer.

What is a Working hypothesis?

It is usually followed that while planning the study of a problem, hypotheses are formed. Initially, they may not be very specific. In such cases, they are referred to as "Working Hypotheses" which are subject to modification as the investigation proceeds.

Null hypotheses are hypothetical statements denying what is explicitly indicated in working hypotheses. They do not, nor were ever intended to exist in reality. They state that *no difference* exists between the parameter and the statistic being compared to it.

What is Question form hypothesis?

In the question form hypothesis, a question is asked as to, what the outcome will be, instead of stating what outcome is expected. Suppose a researcher is interested in knowing whether programmed instruction has any relationship to test anxiety of children.

The level of significance:

This is a very important concept in the context of hypothesis testing. The level of significance is the maximum value of the probability of rejecting Ho when it is true. It is always some percentage (usually 5%) which should be chosen with great care, thought and reason. In case we take the significance level at 5 per cent, then this implies that the Null hypothesis will be rejected. When the sampling result (i.e. observed evidence) has a less than 0.05 probability of occurring if Ho is true. In other words, the 5 per cent level of significance means that the researcher is willing to take as much as a 5 per cent risk of rejecting the null hypothesis when Null hypothesis Ho happens to be true. Thus, the significance level is the maximum value of the probability of rejecting the Null Hypothesis when it is true and is usually determined in advance before testing the hypothesis.

What is the Two-tailed test:

Two -tailed test is a statistical test in which the critical area of a distribution is two-sided and tests whether a sample is either greater than or less than a certain range of values. If the sample that is being tested falls into either of the critical areas, the alternative hypothesis will be accepted instead

of the null hypothesis. The two-tailed test gets its name from testing the area under both of the tails (sides) of a normal distribution, although the test can be used in other non-normal distributions. For example, A candy plant wants to make sure that the number of candies per bag is around 50. The factory is willing to accept between 45 and 55 candies per bag. It would be too costly to have someone check every bag, so the factory selects random samples of the bags and tests whether the average number of candies exceeds 55 or is less than 45 with whatever level of significance it chooses.

What is One -Tailed Test

A statistical test in which the critical area of a distribution is one -sided so that it is either greater than or less than a certain value, but not both. If the sample that is being tested falls into the one-sided critical area, the alternative hypothesis will be accepted instead of the null hypothesis. The one-tailed test gets its name from testing the area under one of the tails (sides) of a normal distribution, although the test can be used in other non-normal distributions as well. An example of when one would want to use a one-tailed test is in the error rate of a factory. A label manufacturer wants to make sure that errors on labels are below 1%. It would be too costly to have someone check every label, so the factory selects random samples of the labels and tests whether errors exceed 1% with whatever level of significance they choose. This represents the implementation of a one-tailed test. In the context of hypothesis testing, these two terms are quite important.

ERRORS IN TESTING OF HYPOTHESIS

Type I and Type II errors: in the context of testing of hypotheses, there are two types of errors we can make. We may reject H_0 when H_0 is true and we may accept H_0 when in fact H_0 is not true.

The former is known as Type I error and the latter as Type II error. In other words, Type I error means rejection of hypothesis which should have been accepted and Type II error means accepting the hypothesis which should have been rejected. Type I error is denoted by (α) known as (alpha) error, also called the level of significance of test; and Type II error is denoted by ß (beta) known as ß error. In a tabular form, the said two errors can be presented as follows: H_0

TYPE I ERROR

A type I error, also known as an error of the first kind, occurs when the null hypothesis (H0) is true but is rejected. It is asserting something absent, a false hit. A type I error may be compared with a so-called false positive (a result that indicates that a given condition is present when it is not present) in tests where a single condition is tested for. Type I errors are philosophically a focus of scepticism and Occam's razor. A Type I error occurs when we believe a falsehood. In terms of folk tales, an investigator may be "crying wolf" without a wolf in sight (raising a false alarm) (H0: no wolf). The rate of the type I error is called the size of the test and denoted by the Greek letter α (alpha). It usually equals the significance level of a test, which is the probability of rejecting the null hypothesis given that it is true. In the case of a simple null hypothesis, α is the probability of a type I error. If the null hypothesis is composite, α is the maximum (supremum) of the possible probabilities of a type I error.

Example 1

Hypothesis: "Adding water to toothpaste protects against cavities."

Null hypothesis: "Adding water to toothpaste does not affect cavities."

This null hypothesis is tested against experimental data to nullify it with evidence to the contrary.

A type I error occurs when detecting an effect (adding water to toothpaste protects against cavities) that is not present. The null hypothesis is true (i.e., it is true that adding water to toothpaste does not affect cavities), but this null hypothesis is rejected based on bad experimental data.

TYPE II ERROR

A type II error, also known as an error of the second kind, occurs when the null hypothesis is false, but erroneously fails to be rejected. It is failing to assert what is present, a miss. A type II error may be compared with a so-called false negative (where an actual 'hit' was disregarded by the test and seen as a 'miss') in a test checking for a single condition with a definitive result of true or false. A Type II error is committed when we fail to believe the truth. In terms of folk tales, an investigator may fail to see the wolf ("failing to raise an alarm"). Again, H0: no wolf. The rate of the type II error is denoted by the Greek letter β (beta) and related to the power of a test (which equals 1−β). What we call type I or type II error depends directly on the null hypothesis. The negation of the null hypothesis causes type I and type II errors to switch roles. The goal of the test is to determine if the null hypothesis can be rejected. A statistical test can either reject or fail to reject a null hypothesis, but never prove it true.

Example 2

Hypothesis: "Adding fluoride to toothpaste protects against cavities."

Null hypothesis: "Adding fluoride to toothpaste does not affect cavities."

This null hypothesis is tested against experimental data to nullify it with evidence to the contrary.

A type II error occurs when failing to detect an effect (adding fluoride to toothpaste protects against cavities) that is present. The null hypothesis is

false (i.e., adding fluoride is effective against cavities), but the experimental data is such that the null hypothesis cannot be rejected.

Decision rule or test of the hypothesis:

Given a hypothesis H_0 and an alternative hypothesis $H\alpha$ we make a rule which is known as decision rule according to which we accept H_0 (i.e. reject Ha) or reject H_0 (ie. accept Ha). For instance, if H_0 is that a certain lot is good (there are very few defective items in it) against $H\alpha$ that the lot is not good (there are too many defective items in it), then we must decide the number of items to be tested and the criterion for accepting or rejecting the hypothesis. We might test 10 times in the lot and plan our decision saying that if there are none or only 1 defective item among the 10, we will accept H_0 otherwise we will reject H_0(or accept Ha). This sort of basis is known as a decision rule.

UNIT - 4: SAMPLING TECHNIQUES

Sampling design, Steps in sampling design, Characteristics of a good sample design, Types of sampling: Probability sampling: random, Stratified random, Systematic, Cluster Multi-stage random sampling – Non-probability sampling: Purposive, Quota, Convenience, Sequential, Snowbell sampling,

What is VARIABLE?

In **research,** variables refer to:

- The measurable **characteristics** of a particular individual / object being studied.
- The measurable **qualities** being studied.
- The measurable **traits or attributes** being studied.

Or

- Variables are properties or characteristics of some event, object or person that can take on different values or amounts.
- A variable is an object, event, idea, feeling, time period, or any other type of category that a researcher trying to measure.

Variables are things that we measure, control, or manipulate in research. They are typically the focus of a study.

It is important to note that variables may have the following characteristics:

- Firstly, they have a period when they start and stops.
- Secondly, they may have a pattern such as daily, weekly, ad-hoc (meaning - created or done for a particular purpose as necessary) and monthly.
- Thirdly they may give an in-depth knowledge about the study

TYPES OF VARIABLES:

There are so many variables in research. It is impossible or extremely difficult to account for all of them because what can be considered a variable in one study may not necessarily be a variable in another study. The types of variables we use in educational research are:

A. Independent variable (IV)

Independent Variable or Experimental Variable or Manipulated Variable or Treatment Variable or Grouping Variable. Independent variables are variables which are manipulated or controlled or changed by the researcher.
Or

Independent Variable is measured, manipulated or selected by the researcher to determine its relationship to an observed phenomenon. In a research study, independent variables are antecedent conditions that are presumed to affect a dependent variable. They are either manipulated or observed by the researcher, so that their values can be related to that of the dependent variable. The independent variable (IV) is often called input variable.

B. Dependent variables:

Dependent variables are the **outcome variables** and are the variables for which we calculate statistics. The variable which changes **on account of** independent variable is **known as dependent variable**.

Example 1, A study of the effect of **teacher support** and **academic achievement.**

The independent variable is **teacher support**

The dependent variable is **academic achievement**.

The terms dependent and independent variable apply mostly to experimental research where some variables are manipulated and, in this sense, they are "independent" from the initial reaction.

C. Extraneous variable:

Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables.

Example- There is a relationship between motivation and student's achievement

In this case **motivation** is an **independent variable** and student's achievement is a dependent variable. **Intelligence** may as well affect the achievement, but it is not related to the purpose of the study undertaken by the researcher, but it will be termed as an extraneous variable.

What is 'experimental error' in research?

If there is any effect as a result of the influence / presence of extraneous variable on dependent variable such result 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.

D. Intervening variables:

Intervening variables intervene between cause and effect. It is difficult to observe, as they are related with individuals' feelings such as boredom,

fatigue excitement. At times some of these variables cannot be controlled or measured but have an important effect upon the result of the study as it intervenes between cause and effect. Though difficult, it has to be controlled through appropriate design.

Example - Effect of immediate reinforcement on learning the parts of speech.

Factors other than reinforcement such as anxiety, fatigue, and motivation may be intervening variables. They are difficult to define in operational, observable terms however they cannot be ignored and must be controlled using appropriate research design.

What is Universe or Population?

Population refers to the totality of objects or totality of individuals

Or

It refers to the group of people, items or units under investigation and includes every individual.

Population is a complete set of elements (persons or objects) that possess some common characteristics defined by the sampling criteria established by the researcher.

A research population is generally a large collection of individuals or objects that is the main focus of a scientific query. It is for the benefit of the population that researches are done. However, due to the large sizes of populations, researchers often cannot test every individual in the population because it is too expensive and time-consuming. This is the reason why researchers rely on sampling techniques. A research population is also known as a well-defined collection of individuals or objects known to have similar

characteristics. All individuals or objects within a certain population usually have a common, binding characteristic or trait.

Two Types of Population in Research

What is Target Population?

Target population refers to the entire group of individuals or objects to which researchers are interested in generalizing the conclusions. The target population usually has varying characteristics and it is also known as the theoretical population.

What is Accessible Population?

The accessible population is the population in research to which the researchers can apply their conclusions. This population is a subset of the target population and is also known as the study population. It is from the accessible population that researchers draw their samples.

What is Sample?

> *Sampling is defined as the process of selecting certain members or a subset of the population to make statistical inferences from them and to estimate characteristics of the whole population.*

It is a collection consisting of a part or subset of the objects or individuals of population. A sample is a finite part of a statistical population whose properties are studied to gain information about the whole (Webster, 1985). When dealing with people, it can be defined as a set of respondents (people) selected from a larger population for the purpose of a survey.

Sampling: It is the process of selecting a sample from the population. For this population is divided into a number of parts called Sampling Units. Or Sampling is the process of selecting a sample from the target population.

What are the advantages of sampling?

Sampling helps the researcher in many aspects which includes:

Economy in expenditure: If the data are collected for the entire population, cost will be very high. It is economical of cost, when the data are collected from a sample which is only a fraction of the population i.e., sampling helps to reduce the cost in the research. Economy in time: The use of sampling is economical of time also. Sampling is less time consuming than census technique. Tabulation, analysis etc. also takes much less time in the case of a sample than in the case of a population. That means sampling helps greater speed in the project.

Economy in time: The use of sampling is economical of time also. Sampling is less time consuming than census technique. Tabulation, analysis etc. also takes much less time in the case of a sample than in the case of a population. That means sampling helps greater speed in the project.

Greater Scope: Handling data becomes easier and manageable in case of a sample. Moreover comprehensive scope and flexibility exists in the case of a sample. The quality of a study is often better with sampling than with a complete coverage.

Increased speed: The process of research like collection of data, analysis and Interpretation of data etc take less time than the population. It provides much quicker results.

Accuracy: Due to limited area of coverage, completeness and accuracy is possible. The processing of data is done accurately producing authentic results. It is the only procedure possible, if the population is infinite.

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

What are the disadvantages of Sampling?

Biasedness: Chances of biased selection leading to erroneous conclusions may prevail. Bias in the sample may be due to faulty method of selection of individuals or the nature of phenomenon itself.

Selection is not a true representative sample: It the problem under study is of a complex nature, it becomes difficult to select a true representative sample, and otherwise results will not be accurate & will not be usable.

Need for specialized knowledge: The researcher needs knowledge, training and experience in sampling technique, statistical analysis and calculation of probable error. Lack of those may lead to serious mistakes.

Changeability of units: If the units of 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.

Write a short note about Sampling techniques

There are different types of sampling techniques based on two factors viz. (1) the representation basis and (2) the element selection technique on the representation basis. The sample may be probability sampling or it may be non-probability sampling. On the element basis, the sample may be

either unrestricted or restricted. Here we will discuss about two types of sampling viz.

(a) Probability Sampling and

(b) Non-Probability Sampling.

What is Probability Sampling?

Probability sampling is a sampling method that selects random members of a population by setting a few selection criteria. These selection parameters allow every member to have the equal opportunities to be a part of various samples. A probability sample is one in which each member of the population has an equal chance of being selected.

Non- Probability Sampling

Non probability sampling method is reliant on a researcher's ability to select members at random. This sampling method is not a fixed or pre-defined selection process which makes it difficult for all elements of a population to have equal opportunities to be included in a sample.

Non-probability sampling is a sampling technique where the samples are gathered in a process that does not give all the individuals in the population equal chances of being selected

(2) In probability sampling, randomness (Chance) is the element of control. In non-probability sampling, it relies on personal judgment.

4.7 TYPES OF PROBABILITY SAMPLING:

Following are the types of probability sampling

1) Simple random sampling

2) Systematic sampling

3) Stratified sampling

4) Cluster sampling

5) Multi stage sampling

Simple random sampling

One of the best probability sampling techniques that helps in saving time and resources, is the Simple Random Sampling method. It is a trustworthy method of obtaining information where every single member of a population is chosen randomly, merely by chance and each individual has the exact same probability of being chosen to be a part of a sample.

In statistics, a simple random sample is a subset of individuals (a sample) chosen from a larger set (a population). Each individual is chosen randomly and entirely by chance, such that each individual has the same probability of being chosen at any stage during the sampling process.

For example, A school of 500 teachers, decides on conducting a refresher course for 50 teachers. It is highly likely that they would prefer picking chits out of a bowl. In this case, each of the 500 employees has an equal opportunity of being selected.

Systematic Sampling:

Each member of the sample comes after an equal interval from its previous member. Using systematic sampling method, members of a sample are chosen at regular intervals of a population. It requires selection of a starting point for the sample and sample size that can be repeated at regular intervals. This type of sampling method has a predefined interval and hence this sampling technique is the least time-consuming.

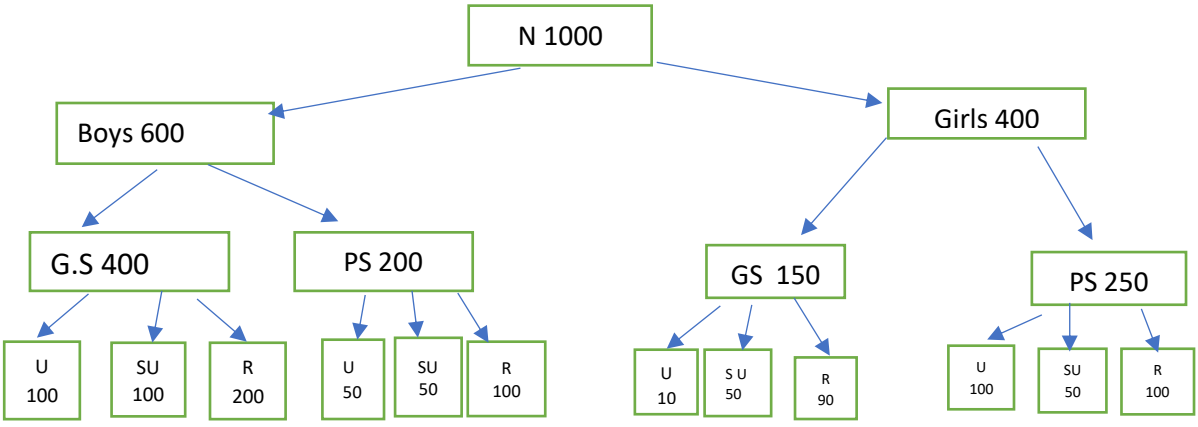
For example, a researcher intends to collect a systematic sample of 500 students in a population of 5000. Each element of the population will be numbered from 1-5000 and every 10th individual will be chosen to be a part of the sample (Total Population/ Sample Size = 5000/500 = 10 %).

Stratified Sampling:

Stratified random sampling is a refinement of simple random sampling. In addition to randomness, Stratified Sampling introduces a secondary element of control as a means of increasing precision and representatives. The population is divided into smaller homogenous group or strata by some characteristic and from each of these strata at random members are selected.

(The population is divided into smaller homogeneous groups or strata by some characteristics and from each of these smaller homogeneous groups draw at random a predetermined no. of units). The usual stratification factors are sex, age, socio-economic status educational back ground, residence, (rural or urban), occupation, political – party affiliation, religion & race. In the standardization of tests and public opinions polls, the method of stratified sampling is necessary.

The following table provides an illustration of selecting a stratified sample for a total of 1000 cases.



Cluster Sampling (Area Sampling):

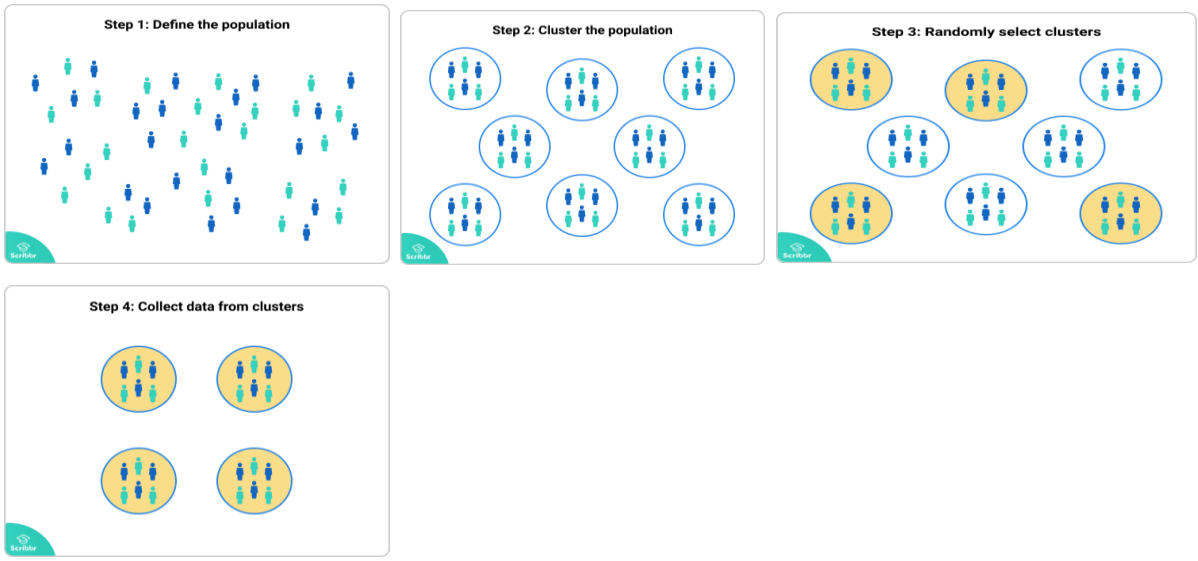
Cluster sampling is a method where the researchers divide the entire population into sections or clusters that represent a population. Clusters are identified and included in a sample on the basis of defining demographic

parameters such as age, location, sex etc. which makes it extremely easy for a researcher to derive effective inference from the feedback.

In this technique, the total population is divided into groups (or clusters) and a simple random sample of the groups is selected. Then the required information is collected from a simple random sample of the elements within each selected group. This may be done for every element in these groups or a subsample of elements may be selected within each of these groups. A common motivation for cluster sampling is to reduce the total number of interviews and costs given the desired accuracy. Assuming a fixed sample size, the technique gives more accurate results when most of the variation in the population is within the groups, not between them.

In cluster sampling, instead of selecting all the subjects from the entire population right off, the researcher takes several steps in gathering his sample population. First, the researcher selects groups or clusters, and then from each cluster, the researcher selects the individual subjects by either simple random or systematic random sampling. The researcher can even opt to include the entire cluster and not just a subset from it. The most common cluster used in research is a geographical cluster. For example, a researcher wants to survey academic performance of high school students in Tamil Nadu. The Researcher can divide the entire population (population of Tamil Nadu) into different clusters (areas). Then the researcher selects a number of clusters depending on his research through simple or systematic random sampling. Then, from the selected clusters (randomly selected areas) the researcher can either include all the high school students as subjects or he can select a number of subjects from each cluster through simple or systematic random sampling.

The important thing to remember about this sampling technique is to give all the clusters equal chances of being selected.



Types of Cluster Sample

One-Stage Cluster Sample - Recall the example given above; one-stage cluster sample occurs when the researcher includes all the high school students from all the randomly selected clusters as sample.

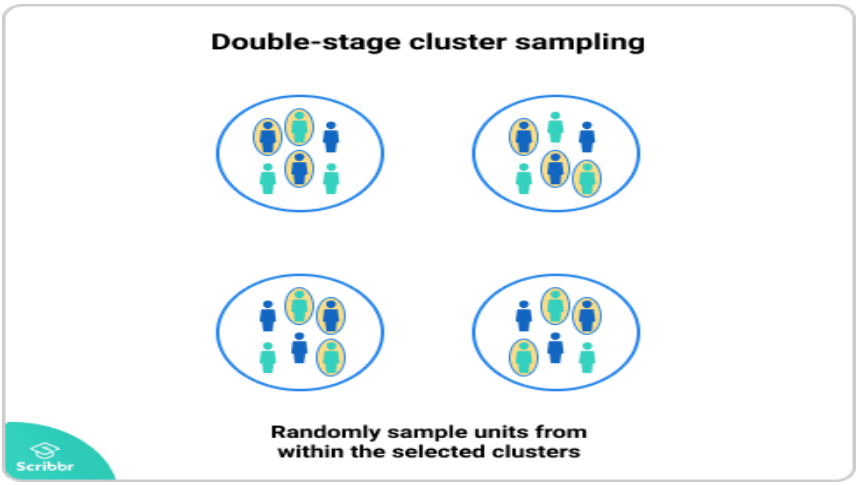
Two-Stage Cluster Sample - From the same example above, two-stage cluster sample is obtained when the researcher only selects a number of students from each cluster by using simple or systematic random sampling.

Difference between Cluster Sampling and Stratified Sampling

The main difference between cluster sampling and stratified sampling lies with the inclusion of the cluster or strata. In stratified random sampling, all the strata of the population is sampled while in cluster sampling, the researcher only randomly selects a number of clusters from the collection of clusters of the entire population. Therefore, only a number of clusters are sampled, all the other clusters are left unrepresented.

Multistage Sampling:

In multi-stage clustering, rather than collect data from every single unit in the selected clusters, the researcher randomly selects individual units from within the cluster for the study.



Non-probability sampling

The following are techniques of non-probability sampling :

a) Purposive Sampling

b) Convenience Sampling

c) Quota Sampling

d) Snowball Sampling

Purposive Sampling:

In this sampling method, the researcher selects a "typical group" of individuals who might represent the larger population and then collects data from this group. For example, if a researcher wants to survey the attitude towards the teaching profession of teachers teaching students from lower socio-economic stratum, he or she might survey the teachers teaching in schools catering to students from slums (more specifically, teachers teaching in Municipal schools) with the assumption that since all teachers teaching

in Municipal schools cater to students from the lower socio-economic stratum, they are representative of all the teachers teaching students from lower socio-economic stratum.

Convenience Sampling : It refers to the procedures of obtaining units or members who are most conveniently available. Here members of the population are chosen based on their relative ease of access.It consists of units which are obtained because cases are readily available. In selecting the incidental sample, the researcher determines the required sample size and then simply collects data on that number of individuals who are available easily.

Quota Sampling: The selection of the sample is made by the researcher, who decides the quotas for selecting sample from specified sub groups of the population. Here, the researcher first identifies those categories which he or she feels are important to ensure the representativeness of the population, then establishes a sample size for each category, and finally selects individuals on an availability basis. For example, an interviewer might be need data from 40 adults and 20 adolescents in order to study students' television viewing habits. He therefore, will go out and select 20 adult men and 20 adult women, 10 adolescent girls and 10 adolescent boys so that they could interview them about their students' television viewing habits.

Snowball Sampling: In snowball sampling, the researcher identifying and selecting available respondents who meet the criteria for inclusion in his/her study. After the data have been collected, the researcher asks for a referral of other individuals, who would also meet the criteria and represent the population of concern.

UNIT 4

VARIABLES AND SCALING TECHNIQUES

MEANING OF VARIABLES

A **variable** is any entity that can take on different values. So what does that mean? Anything that can vary can be considered a variable. For instance, age can be considered a variable because age can take different values for different people or the same person at different times. Similarly, the country can be considered a variable because a person's country can be assigned a value.

A variable is a concept or abstract idea that can be described in measurable terms. In research, this term refers to the measurable characteristics, qualities, traits, or attributes of a particular individual, object, or situation being studied.

Variables are properties or characteristics of some event, object, 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 are given in our research and in the type of measures that can be applied to them.

By itself, the statement of the problem usually provides only general direction for the research study; it does not include all the specific information. There is some basic terminology that is extremely important in how we communicate specific information about research problems and research in general.

Let us analyze an example; if a researcher is interested in the effects of two different teaching methods on the science achievement of fifth-grade students, the grade level is constant, because all individuals involved are fifth-graders. This characteristic is the same for everyone; it is a 'constant' condition of the study. After the different teaching methods have been implemented, the fifth-graders involved would be measured with a science achievement test. It is very unlikely that all of the fifth-graders would receive the same score on this test, hence the score on the science achievement test becomes a variable because different individuals will have different scores; at least, not all individuals will have the same scores. We would say that science achievement is a variable, but we would mean, specifically, that the score on the science achievement test is a variable.

There is another variable in the preceding example – the teaching method. In contrast to the science achievement test score, which undoubtedly would be measured on a scale with many possible values, the teaching method is a categorical variable consisting of only two

categories, the two methods. Thus, we have different kinds of variables and different names or classifications for them.

A concept that can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified based on the presence or absence of the concerning attributes(s). Age is an example of a continuous variable, but the number of male and female respondents is an example of a discrete variable.

TYPES OF VARIABLES:

There are many classification systems given in the literature the names we use are descriptive; they describe the roles that variables play in a research study. The variables described below by no means exhaust the different systems and names that exist, but they are the most useful for communicating about educational research.

1. Independent variables:

Independent variables are variables that are manipulated or controlled or changed. In the example "a study of the effect of teacher praise on the reading achievement of second-graders", the effect of praise, the researcher is trying to determine whether there is a cause-and-effect relationship, so the kind of praise is varied to see whether it produces different scores on the reading achievement test. We call this a manipulated independent variable (treatment variable). The amount and kind of praise are manipulated by the researcher. The researcher could analyze the scores for boys and girls separately to see whether the results are the same for both genders. In this case, gender is a classifying or attributes independent variable. The researcher cannot manipulate gender but can classify the children according to gender.

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 independent variable is known as the dependent variable. Let us take the example, a study of the effect of teacher praise on the reading achievement of second-graders; the dependent variable is reading achievement. We might compare the average reading achievement scores of second-graders in different praise conditions such as no praise, oral praise, written praise, and combined oral and written praise.

The following example further illustrates the use of variables and constants. In a study conducted to determine the effect of three different teaching methods on achievement in elementary algebra, each of three ninth-grade algebra sections in the same school, taught by the same teacher, is taught using one of the methods. Both boys and girls are included in the

study. The constants in the study are grade level, school, and teacher. (This assumes that, except for method, the teacher can hold teaching effectiveness constant.) The independent variables in the study are the teaching method and gender of the student. The teaching method has three levels that arbitrarily can be designated methods A, B, and C; gender of the student, of course, has two levels. Achievement in algebra, as measured at the end of the instructional period, is the dependent variable.

The terms dependent and independent variable 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. That is to say, they depend on "what the subject will do" in response. Somewhat contrary to the nature of this distinction, these terms are also used in studies where we do not 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 whereas dependent variables are only measured or registered.

Consider other examples of independent and dependent variables:

Example 1: A study of teacher-student classroom interaction **at** different levels of schooling.

Independent variable: Level of schooling, four categories – **primary, upper primary, secondary and** junior **college.**

Dependent variable: Score on a classroom observation inventory, which measures teacher-student interaction

Example 2: A **comparative** study of the professional attitudes of **secondary school teachers by gender.**

Independent variable: Gender of the teacher – male, female.

Dependent variable: Score on a professional attitude inventory.

3 .Extraneous variable:

Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their self-concepts. In this case, self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable. Whatever effect is noticed on the 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 Social Science.

Here variables such as teacher's competence, Teacher's enthusiasm, age, socio economic status also contribute substantially to the teaching-learning process. It cannot be controlled by the researcher. The conclusions lack incredibility because of extraneous variables.

4 Intervening variables:

They intervene between cause and effect. It is difficult to observe, as they are related to individuals' feelings such as boredom, fatigue excitement At times some of these variables cannot be controlled or measured but have an important effect upon the result of the study as it intervenes between cause and effect. Though difficult, it has to be controlled through appropriate design.

Eg. "Effect of immediate reinforcement on learning the parts of speech".

Factors other than reinforcement such as anxiety, fatigue, and motivation may be intervening variables. They are difficult to define in operational, observable terms however they cannot be ignored and must be controlled using appropriate research design.

5. Moderator:

A third variable that when introduced into an analysis alters or has a contingent effect on the relationship between an independent and a dependent variable. A moderator variable is an independent variable that is not of primary interest that has levels, which when combined with the levels of the independent variable of interest produces different effects.

For example, suppose that the researcher designs a study to determine the impact of the lengths of reading passages on the comprehension of the reading passage. The design has three levels of passage length: 100 words, 200 words, and 300 words. The participants in the study are fourth-fifth- and sixth-graders. Suppose that the three grade levels all did very well on the 100-word passage, but only the sixth-graders did very well on the 300-word passage. This would mean that successfully comprehending reading passages of different lengths was moderated by grade level.

Types of scales

Scales of measurement in research and statistics are the different ways in which variables are defined and grouped into different categories. Sometimes called the level of measurement, it describes the nature of the values assigned to the variables in a data set.

The term scale of measurement is derived from two keywords in statistics, namely; measurement and scale. Measurement is the process of recording observations collected as part of the research.

Scaling, on the other hand, is the assignment of objects to numbers or semantics. These two words merged refer to the relationship between the assigned objects and the recorded observations.

What is a Measurement Scale?

A measurement scale is used to qualify or quantify data variables in statistics. It determines the kind of techniques to be used for statistical analysis.

There are different kinds of measurement scales, and the type of data being collected determines the kind of measurement scale to be used for statistical measurement. These measurement scales are four in number, namely; nominal scale, ordinal scale, interval scale, and ratio scale.

The measurement scales are used to measure qualitative and quantitative data. Nominal and ordinal scales being used to measure qualitative data while interval and ratio scales are used to measure quantitative data.

Characteristics of a Measurement Scale

Identity

Identity refers to the assignment of numbers to the values of each variable in a data set. Consider a questionnaire that asks for a respondent's gender with the options Male and Female for instance. The values 1 and 2 can be assigned to Male and Females respectively. Arithmetic operations can not be performed on these values, because they are just for identification purposes. This is a characteristic of a nominal scale.

Magnitude

The magnitude is the size of a measurement scale, where numbers (the identity) have an inherent order from least to highest. They are usually represented on the scale in ascending or descending order. The position in a race, for example, is arranged from the 1st, 2nd, 3rd to the least.

This example is measured on an ordinal scale because it has both identity and magnitude.

Equal intervals

Equal Intervals mean that the scale has a standardized order. I.e., the difference between each level on the scale is the same. This is not the case for the ordinal scale example highlighted above.

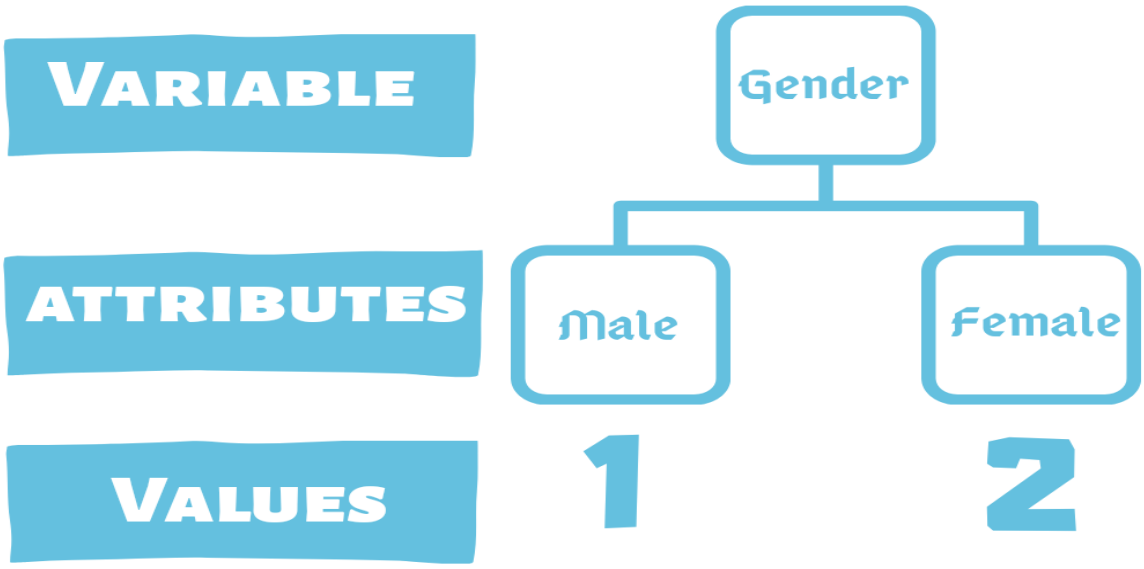
Each position does not have an equal interval difference. In a race, the 1st position may complete the race in 20 secs, the 2nd position in 20.8 seconds while the 3rd in 30 seconds. A variable that has an identity, magnitude, and equal interval is measured on an interval scale.

Absolute zero

Absolute zero is a feature that is unique to a ratio scale. It means that there is an existence of zero on the scale, and is defined by the absence of the variable being measured (e.g. no qualification, no money, does not identify as any gender, etc.

Levels of Data Measurement

The level of measurement of a given data set is determined by the relationship between the values assigned to the attributes of a data variable. For example, the relationship between the values (1 and 2) assigned to the attributes (male and female) of the variable (Gender) is "identity". This via. a nominal scale example.



By knowing the different levels of data measurement, researchers can choose the best method for statistical analysis. The different levels of data measurement are: nominal, ordinal, interval, and ratio scales

Nominal Scale

The nominal scale is a scale of measurement that is used for identification purposes. It is the coldest and weakest level of data measurement among the four.

Sometimes known as categorical scale, it assigns numbers to attributes for easy identity. These numbers are however not qualitative and only act as labels.

The only statistical analysis that can be performed on a nominal scale is the percentage or frequency count. It can be analyzed graphically using a bar chart and pie chart.

For example: In the example below, the measurement of the popularity of a political party is measured on a nominal scale.

Which political party are you affiliated with?

- Independent
- Republican
- Democrat

Labeling Independent as "1", Republican as "2" and Democrat as "3" does not in any way mean any of the attributes are better than the other. They are just used as an identity for easy data analysis.

Ordinal Scale

Ordinal Scale involves the ranking or ordering of the attributes depending on the variable being scaled. The items in this scale are classified according to the degree of occurrence of the variable in question.

The attributes on an ordinal scale are usually arranged in ascending or descending order. It measures the degree of occurrence of the variable.

Ordinal scale can be used in market research, advertising, and customer satisfaction surveys. It uses qualifiers like very, highly, more, less, etc. to depict a degree.

We can perform statistical analysis like median and mode using the ordinal scale, but not mean. However, there are other statistical alternatives to mean that can be measured using the ordinal scale.

For example, A software company may need to ask its users:

How would you rate our app?

- Excellent
- Very Good
- Good
- Bad
- Poor

The attributes in this example are listed in descending order.

Interval Scale

The interval scale of data measurement is a scale in which the levels are ordered and each numerically equal distances on the scale have an equal interval difference. If it is an extension of the ordinal scale, with the main difference being the existence of equal intervals.

With an interval scale, you not only know that a given attribute A is bigger than another attribute B, but also the extent to which A is larger than B. Also, unlike the ordinal and nominal scale, arithmetic operations can be performed on an interval scale.

Minutes Interval Time Scale

It is used in various sectors like education, medicine, engineering, etc. Some of these uses include calculating a student's CGPA, measuring a patient's temperature, etc.

A common example is measuring temperature on the Fahrenheit scale. It can be used in calculating mean, median, mode, range, and standard deviation.

Ratio Scale

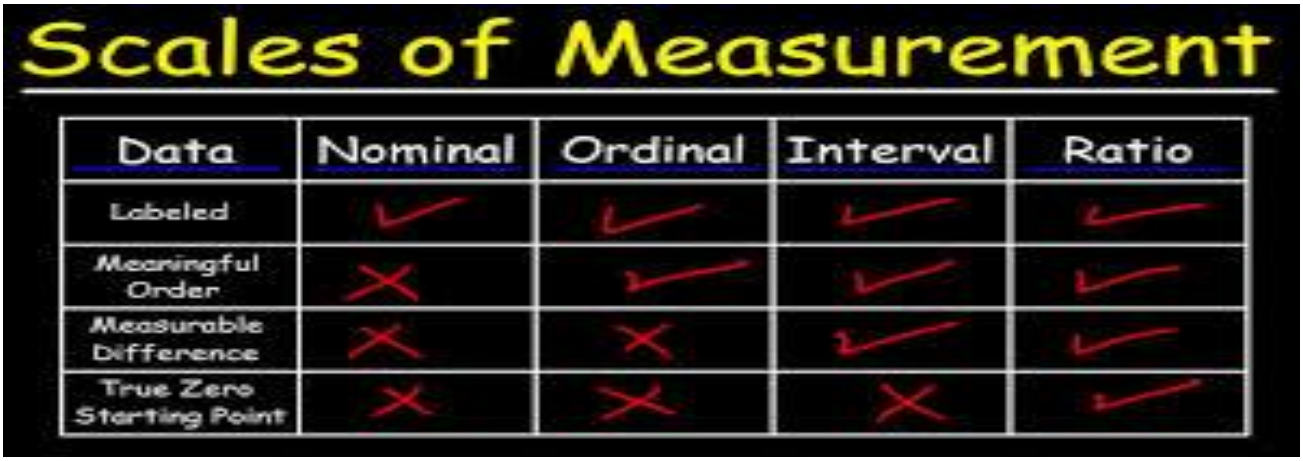
The Ratio Scale is the peak level of data measurement. It is an extension of the interval scale, therefore satisfying the four characteristics of measurement scale; identity, magnitude, equal interval, and the absolute zero property.

This level of data measurement allows the researcher to compare both the differences and the relative magnitude of numbers. Some examples of ratio scales include length, weight, time, etc. Concerning market research, the common ratio scale examples are price, number of customers, competitors, etc. It is extensively used in marketing, advertising, and business sales. The ratio scale of data measurement is compatible with all statistical analysis methods like the measures of central tendency (mean, median, mode, etc.) and measures of dispersion (range, standard deviation, etc.).

For example A survey that collects the weights of the respondents.

Which of the following category do you fall in? Weigh

- more than 100 kgs
- 81 - 100 kgs
- 61 - 80 kgs
- 40 - 60 kgs
- Less than 40 kgs



Types of Measurement Scale

There are two main types of measurement scales, namely; comparative scales and non-comparative scales.

Comparative Scales

In comparative scaling, respondents are asked to make a comparison between one object and the other. When used in market research, customers are asked to evaluate one product in direct comparison to the others. Comparative scales can be further divided into pair comparison, rank order, constant sum, and q-sort scales.

- **Paired Comparison Scale**

Paired Comparison scale is a scaling technique that presents the respondents with two objects at a time and asks them to choose one according to a predefined criterion. Product researchers use it in comparative product research by asking customers to choose the most preferred to them in between two closely related products.

For example, there are 3 new features in the last release of a software product. But the company is planning to remove 1 of these features in the new release. Therefore, the product researchers are performing a comparative analysis of the most and least preferred feature.

1. Which feature is most preferred to you between the following pairs?

- Filter - Voice recorder
- Filter - Video recorder
- Voice recorder - Video recorder

Rank Order Scale:

In the rank order scaling technique, respondents are simultaneously provided with multiple options and asked to rank them in order of priority based on a predefined criterion. It is mostly used in marketing to measure preference for a brand, product, or feature. When

used in competitive analysis, the respondent may be asked to rank a group of brands in terms of personal preference, product quality, customer service, etc. The results of this data collection are usually obtained in the conjoint analysis, as it forces customers to discriminate among options.

The rank order scale is a type of ordinal scale because it orders the attributes from the most preferred to the least preferred but does not have a specific distance between the attributes.

For example:

Rank the following brands from the most preferred to the least preferred.

- Coca-Cola
- Pepsi Cola
- Dr pepper
- Mountain Dew

Constant Sum Scale

The constant Sum scale is a type of measurement scale where the respondents are asked to allocate a constant sum of units such as points, dollars, chips, or chits among the stimulus objects according to some specified criterion. The constant sum scale assigns a fixed number of units to each attribute, reflecting the importance a respondent attaches to it. This type of measurement scale can be used to determine what influences a customer's decision when choosing which product to buy. For example, you may wish to determine how important price, size, fragrance, and packaging are to a customer when choosing which brand of perfume to buy.

Some of the major setbacks of this technique are that respondents may be confused and end up allocating more or fewer points than those specified. The researchers are left to deal with a group of data that is not uniform and may be difficult to analyze.

Q-Sort Scale

Q-Sort scale is a type of measurement scale that uses a rank order scaling technique to sort similar objects concerning some criterion. The respondents sort the number of statements or attitudes into piles, usually of 11.

The Q-Sort Scaling helps in assigning ranks to different objects within the same group, and the differences among the groups (piles) are visible. It is a fast way of facilitating discrimination among a relatively large set of attributes.

For example, a new restaurant that is just preparing its menu may want to collect some information about what potential customers like:

The document provided contains a list of 50 meals. Please choose 10 meals you like, 30 meals you are neutral about (neither like nor dislike), and 10 meals you dislike.

Non-Comparative Scales

In non-comparative scaling, customers are asked to only evaluate a single object. This evaluation is independent of the other objects under investigation. Sometimes called monadic or metric scale, the Non-Comparative scale can be further divided into continuous and the itemized rating scales

- **Continuous Rating Scale**

In the continuous rating scale, respondents are asked to rate the objects by placing a mark appropriately on a line running from one extreme of the criterion to the other variable criterion. Also called the graphic rating scale, it gives the respondent the freedom to place the mark anywhere based on personal preference. Once the ratings are obtained, the researcher splits up the line into several categories and then assigns the scores depending on the category in which the ratings fall. This rating can be visualized in both horizontal and vertical forms. Although easy to construct, the continuous rating scale has some major setbacks, giving it limited usage in market research.

- **Itemized Rating Scale**

The itemized rating scale is a type of ordinal scale that assigns numbers to each attribute. Respondents are usually asked to select an attribute that best describes their feelings regarding a predefined criterion.

Itemized rating scale is further divided into 2, namely; Likert scale, Stapel scale, and semantic scale.

- Likert Scale: A Likert scale is an ordinal scale with five response categories, which is used to order a list of attributes from the best to the least. This scale uses adverbs of degree like very strongly, highly, etc. to indicate the different levels.
- Stapel Scale: This a scale with 10 categories, usually ranging from -5 to 5 with no zero points. It is a vertical scale with 3 columns, where the attributes are placed in the middle and the least (-5) and highest (5) is in the 1st and 3rd columns respectively.
- Semantic Differential Scale: This is a seven-point rating scale with endpoints associated with bipolar labels (e.g. good or bad, happy, etc.). It can be used for marketing, advertising, and in different stages of product development.

UNIT 5

TOOLS OF RESEARCH

TOOLS

INTRODUCTION :

In every research work, it is essential to collect factual material or data unknown or untapped so far. They can be obtained from many sources, direct or indirect. It is necessary to adopt a systematic procedure to collect essential data. Relevant data, adequate in quantity and quality should be collected. They should be sufficient, reliable, and valid.

For checking new, unknown data required for the study of any problem you may use various devices, instruments, apparatus, and appliances. For every type of research, we need certain instruments to gather new facts or to explore new fields. The instruments thus employed as means for collecting data are called tools.

The selection of suitable instruments or tools is of vital importance for successful research. Different tools are suitable for collecting various kinds of information for various purposes. The research worker may use one or more of the tools in combination for his purpose. Research students should therefore familiarise themselves with the varieties of tools with their nature, merits, and limitations. They should also know how to construct and use them effectively. The systematic way and procedure by which a complex or scientific task is accomplished are known as the technique. Techniques are the practical method, skill or art applied to a particulate task. So, as a researcher, we should aware of both the tools and techniques of research.

The major tools of research in education can be classified broadly into the following categories.

A. Inquiry forms

Questionnaire

Checklist

Score-card

Schedule

Rating Scale

Opinionnaire

Attitude Scale

B. Observation

C. Interview

D. Sociometry

E. Psychological Tests

Achievement Test

Aptitude Test

Intelligence Test

Interest inventory

Personality measures etc

RATING SCALE :

The rating scale is one of the enquiry forms. The form is a term applied to expression or judgment regarding some situation, object, or character. Opinions are usually expressed on a scale of values. Rating techniques are devices by which such judgments may be quantified. The rating scale is a very useful device in assessing quality, especially when quality is difficult to measure objectively. For Example, —How good was the performance?‖ is a question that can hardly be answered objectively.

Rating scales record judgment or opinions and indicate the degree or amount of different degrees of quality **which** are arranged along a line is the scale. For **e**xample: How good was the performance?

Excellent Very good Good Average Below average Poor Very poor

___|_____|_____|____|_____|_____|____|___

This is the most commonly used instrument for making appraisals. It has a large variety of forms and uses. Typically, they direct attention to several aspects or traits of the thing to be rated and provide a scale for assigning values to each of the aspects selected. They try to measure the nature or degree of certain aspects or characteristics of a person or phenomenon through the use of a series of numbers, qualitative terms, or verbal descriptions.

Ratings can be obtained through one of three major approaches:

- Paired comparison
- Ranking and
- Rating scales

The first attempt at rating personality characteristics was the man-to-man technique devised curing World-war-I. This technique calls for a panel of raters to rate every individual in comparison to a standard person. This is known as the paired comparison approach. In the ranking approach, every single individual in a group is compared with every other individual and to arrange the judgment in the form of a scale. In the rating scale approach which is the more common and practical method rating is based on the rating scales, a procedure which consists of assigning to each trait being rated a scale value giving a valid

estimate of its status, and then comparing the separate ratings into an overall score. **Purpose of Rating Scale:**

Rating scales have been successfully utilized for measuring the following:

- Teacher **Performance/Effectiveness**
- Personality, **anxiety, stress, emotional intelligence, etc.**
- School appraisal including an appraisal of courses, practices, and programs.

Useful hints on Construction of Rating Scale:

A rating scale includes three factors:

i) The subjects or the phenomena to be rated.

ii) The continuum along which they will be rated and

iii) The judges will do the rating.

All taken three factors should be carefully taken care of by you when you construct the rating scale.

1) The subjects or phenomena to be rated are usually a limited number of aspects of a thing or a trait of a person. Only the most significant aspects of the study should be chosen. The usual way to get a judgment is on five-to-seven-point scales as we have already discussed.

2) The rating scale is always composed of two parts:

i) An instruction that names the subject and defines the continuum and

ii) A scale that defines the points to be used in rating.

3) Anyone can serve as a rater where non-technical opinions, likes and dislikes, and matters of easy observation are to be rated. But only well-informed and experienced persons should be selected for rating where technical competence is required. Therefore, you should select experts in the field as rater or a person who form a sample of the population in which the scale will subsequently be applied. Pooled judgments increase the reliability of any rating scale. So employ several judges, depending on the rating situation to obtain desirable reliability.

Use of Rating Scale :

Rating scales are used for testing the validity of many objective instruments like paper-pencil inventories of personality.

They are also advantaging in the following fields:

- Helpful in writing reports to parents
- Helpful in filling out admission blanks for colleges
- Helpful in finding out student needs

- Stimulating effect upon the individuals who are rated

Limitations of Rating Scale :

The rating scales suffer from many errors and limitations like the following:

As you know that the raters would not like to run down their people by giving them low ratings. So in that case they give high ratings to almost all cases. Sometimes also the raters are included to be unduly generous in rating aspects which they had to opportunity to observe. If the raters rate on the higher side due to those factors, then it is called the generosity error of rating.

The Errors of Central Tendency :

Some observe wants to keep them in a safe position. Therefore, they rate near the midpoint of the scale. They rate almost all as average. **Stringency Error :**

Stringency error is just the opposite of generosity of error. These types of raters are very strict, cautious, and hesitant in rating on the average and higher sides. They tend to rate all individuals low.

The Hallo Error :

When a rater rates one aspect influenced by other is called the hallo effect. For if a person will be rated on the higher side on his achievement because of his punctually or sincerely irrespective of his perfect answer it called as hallo effect. The biased-ness of the rater affects one quality to other.

The Logical Error :

It is difficult to convey to the rater just what quality one wishes him to evaluate. An adjective or Adverb may have no universal meaning. If the terms are not properly understood by the rater and he rates, then it is called the logical error. Therefore, brief behavioral statements having clear objectives should be used.

ATTITUDE SCALE :

Attitude scale is a form of appraisal procedure and it is also one of the inquiry terms. Attitude scales have been designed to measure the attitude of a subject of a group of subjects towards issues, institutions, and groups of peoples. The term attitude is defined in various ways, —the behavior which we define as attitudinal or attitude is a certain observable set‖ organism or relative tendency preparatory to and indicative of more complete adjustment. says L. L. Bernard. An attitude may be defined as a learned emotional response set for or against something says - Barr David Johnson

An attitude is spoken of as a tendency of an individual to read in a certain way towards a Phenomenon. It is what a person feels or believes in. It is the inner feeling of an individual. It may be positive, negative, or neutral. Opinion and attitude are used sometimes in a synonymous manner but there is a difference between the two. You will be able to know when we will discuss the opinionnaire. An opinion may not lead to any kind of activity in a particular direction. But an attitude compels one to act either favorably or unfavorably according to what they perceive to be correct. We can evaluate attitude through a questionnaire. But it is ill-adapted for scaling accurately the intensity of an attitude. Therefore, the Attitude scale is essential as it attempts to minimize the difficulty of opinionnaire and questionnaire by defining the attitude in terms of a single attitude object. All items, therefore, may be constructed with graduations of favor or disfavor.

Purpose of Attitude Scale :

In educational research, these scales are used especially for finding the attitudes of persons on different issues like:

- Co-education
- Religious education
- Corporal punishment
- Democracy in schools
- Linguistic prejudices
- International co-operation etc.

Characteristics of Attitude Scale :

The attitude scale should have the following characteristics.

- It provides for the quantitative measure on a unidimensional scale of the continuum.
- It uses statements from an extremely positive to an extremely negative position.
- It generally uses a five-point scale as we have discussed in the rating scale.
- It **could be standardized** and norms are worked out.
- It disguises the attitude object rather than directly asking about the attitude on the subject.

Examples of Some Attitude Scale :

Two popular and useful methods of measuring attitudes indirectly, commonly used for research purposes are:

- Thurstone Techniques of scaled values.
- Likert's method of summated ratings.

Thurstone Technique: Thurstone Technique is used when the attitude is accepted as a uni-dimensional linear Continuum. The procedure is simple. A large number of statements of various shades of favourable and unfavourable opinion on slips of paper, which a large number of judges exercising complete detachment sort out into eleven plies ranging from the most hostile statements to the most favourable ones. The opinions are carefully worded to be clear and unequivocal. The judges are asked not to express tier opinions but to sort them at their face value. The items which bring out a marked disagreement between the judges un assigning a position are discarded. Tabulations are made which indicate the number of judges who placed each item in each category. The next step consists of calculating cumulated proportions for each item and ogives are constructed. Scale values of each item are read from the ogives, the values of each item being that point along the baseline in terms of scale value units above and below which 50% of the judges placed the item. It 'll be the median of the frequency distribution in which the score ranges from 0 to 11.

The Likert Scale :

The Likert scale uses items worded for or against the proposition, with a five-point rating response indicating the strength of the respondent's approval or disapproval of the statement. This method removes the necessity of submitting items to the judges for working out scaled values for each item. It yields scores very similar to those obtained from the Thurstone scale. It is important over the Thurstone method.

The first step is the collection of a member of statements about the subject in question. Statements may or may not be correct but they must be representative of opinion held by a substantial number of people. They must express definite favourableness or unfavourableness to a particular point of view. The number of favourable and unfavourable statements should be approximately equal. A trial test maybe administered to a number of subjects. Only those items that correlate with the total test should be retained.

The Likerts calling techniques assigns a scale value to each of the five responses. All favourable statements are scored from maximum to minimum i. e. from a score of 5 to a score of one or 5 for strongly agree and so on 1 for strongly disagree. The negative statement or statement apposing the proposition would be scored in the opposite order . e. from a score of 1 to a score of 5 or 1 for strongly agree and so on 5 for strongly disagree.

The total of these scores on all the items measures a respondent's favourableness towards the subject in question. It a scale consists of 30 items, Say, the following score values will be of interest.

30x5 = 150 Most favourable response possible

30x3 = 90 A neutral attitude

30x1 = 30 Most unfavourable attitude

It is thus known as a method of summated ratings. The summed-up score of any individual would fall between 30 and 150. scores above 50 will indicate a favourable and scores below go an unfavourable attitude.

Limitations Of Attitude Scale :

In the attitude scale, the following limitations may occur: An individual may express a socially acceptable opinion conceal his real attitude.

- An individual may not be a good judge of himself and may not be aware of his real attitude.
- He may not have been controlled with a real situation to discover what his real attitude towards a specific phenomenon was.
- There is no basis for believing that the five positions indicated in the Likert scale are equally spaced.
- It is unlikely that the statements are of equal value in _forness' or —againstness‖.
- It is doubtful whether equal scores obtained by several individuals would indicate equal favourableness towards again position.
- It is unlikely that a respondent can validity react to a short statement on a printed form in the absence of a real qualifying Situation.
- In sprite of anonymity of response, Individuals tend to respond according to what they should feel rather than what they feel.

However, until more precise measures are developed, the attitude scale remains the best device to measure attitudes

OPINIONNAIRE :

Opinion polling or opinion gauging represents a single-question approach. The answers are usually in the form of _yes' or _no'. An undecided category is often included. Sometimes a large number of response alternatives if provided says - Anna Anastusi

The terms opinion and attitude are not synonymous, though sometimes we use them synonymously. We have till now discussed that attitudes scale. We have also discussed that attitudes are impressed opinions. You can now understand the difference between the

opinionnaire and attitude scale, when we discuss of out opinionnaire, it is characteristics, and purposes.

The opinion is what a person says on certain aspects of the issue under consideration. It is an outward expression of an attitude held by an individual. Attitudes of an individual can be inferred or estimated from his statements of opinion.

An opinionnaire is defined as a special form of inquiry. It is used by the researcher to collect the opinions of a sample of population on certain facts or factors the problem under investigation. These opinions on different facts of the problem under study are further quantified, analyzed, and interpreted.

Purpose :

Opinionnaire is usually used in researches of the descriptive type which demands a survey of opinions of the concerned individuals. Public opinion research is an example of an opinion survey. Opinion polling enables the researcher to forecast the coming happenings successfully.

Characteristics :

- The opinionnaire makes use of statements or questions on different aspects of the problem under investigation.
- Responses are expected either on three-point or five-point scales.
- It uses favorable or unfavorable statements.
- It may be sub-divided into sections.
- The gally poll ballots generally make use of questions instead of statements.
- The public opinion polls generally rely on personal contacts rather than mail ballots.

QUESTIONNAIRE :

A questionnaire is a form prepared and distributed to secure responses to certain questions. It is a device for securing answers to questions by using a form that the respondent fills by himself. It is a systematic compilation of questions that are submitted to a sampling of the population from which information is desired.

Questionnaires rely on written information supplied directly by people in response to questions. The information from questionnaires tends to fall into two broad categories – _facts‘ and _opinions‘. It is worth stressing that, in practice, questionnaires are very likely to include questions about both facts and opinions. **Purpose :**

The purpose of the questionnaire is to gather information from widely scattered sources. It is mostly used in uses in cases where one can not readily see personally all of the people

from whom he desires responses. It is also used where there is no particular reason to see their personality.

Types: Questionnaire can be of various types based on their preparation. They are like:

- Structured **v/s** Non Structured
- Closed **v/s** Open
- Fact **v/s** Opinion

Structured v/s Non-Structured Questionnaire :

The structured questionnaire contains definite, concrete, and directed questions, where a non-structured questionnaire is often used in interviews and guides. It may consist of partially completed questions.

Closed v/s Open Questionnaire :

The question that calls for short check responses is known as restricted or closed-form type. For Example, they provide for marking a yes or no, a short response, or checking an item from a list of responses. Here the respondent is not free to write of his own, he was to select from the selected from the supplied responses. On the other hand, with an increase of open-ended questionnaires, the respondent is free to respond in his own words. Many questionnaires also included both close and open-type questions. The researcher selects the type of questionnaire according to his need of the study.

Fact and Opinion :

In the case of a fact questionnaire, the respondent is expected to give information of facts without any reference to his opinion or attitude about them.

But in the case of an opinion questionnaire the respondent gives the information about the facts with his own opinion and attitude.

Planning the Use of Questionnaire :

The successful use of the questionnaire depends on devoting the right balance of effort to the planning stage, rather than rushing too early into administering the questionnaire. Therefore, the researcher should have a clear plan of action in mind, and costs, production, organization, schedule, and permission should be taken care of in the beginning. When designing a questionnaire, the characteristics of a good questionnaire should be kept in mind.

Characteristics of A Good Questionnaire :

- The questionnaire should deal with an important or significant topic to create interest among respondents.
- It should seek only that data that can not be obtained from other sources.

- It should be as short as possible but should be comprehensive.
- It should be attractive.
- Directions should be clear and complete.
- It should be represented in good Psychological order proceeding from general to more specific responses.
- Double negatives in questions should be avoided.
- Putting two questions in one question also should be avoided.
- It should avoid annoying or embarrassing questions.
- It should be designed to collect information that can be used subsequently as data for analysis.
- It should consist of a written list of questions.
- The questionnaire should also be used appropriately.

When is it appropriate to use a questionnaire for research?

Different methods are better suited to different circumstances and questionnaires are no exception to it. Questionnaire is used at their most productive:

- When used with large numbers of respondents.
- When what is required tends to be fairly straightforward information.
- When there is a need to standardize data from identical information.
- When time is allowed for delays.
- When resources allow for the cast of printing and postage.
- When respondents can be expected to be able to read and understand the questions.

Designs of Questionnaire

After the construction of questions based on their characteristics, it should be designed with some essential routines like:

- Background information about the questionnaire.
- Instructions to the respondent.
- The allocation of serial numbers and
- Coding Boxes.

Background Information about The Questionnaire

Both from an ethical and practical point of view, the researcher needs to provide sufficient background information about the research and the questionnaire. Each questionnaire should have a cover page, on which some information appears about:

- The sponsor
- The purpose
- Return address and date
- Confidentiality
- Voluntary responses and
- Thanks

Instructions to the Respondent :

Respondents must be instructed to go presented at the start of the questionnaire which indicates what is expected from the respondents. Specific instructions should be given for each question where the style of questions varies throughout the questionnaire. For Example – Put a tick mark in the appropriate box and circle the relevant number etc.

The Allocation of Serial Numbers :

Whether dealing with small or large numbers, a good researcher needs to keep good records. Each questionnaire therefore should be numbered.

Advantages of Questionnaire :

Questionnaires are economical. In terms of materials, money, and time it can supply a considerable amount of research data.

- It is easier to arrange.
- It supplies standardized answers
- It encourages pre-coded answers.
- It permits wide **coverage**.
- It helps in conducting depth study.

Disadvantages :

- It **is reliable** and **valid, but** slow.
- Pre-coding questions can deter them from answering.
- Pre-coded questions can bias the findings towards the researcher.
- The postal questionnaire offers few opportunities to check the truthfulness of the answers.
- It cannot be used with illiterate and small children.

Criteria of Evaluating a Questionnaire:

You can evaluate your questionnaire whether it is a standard questionnaire or not based on the following criteria:

- It should provide full information about the area of research.
- It should provide accurate information.

- It should have a decent response rate.
- It should adopt an ethical stance and
- It should be feasible.
- Like all the tools, it also has some advantages and disadvantages based on its uses.

CHECKLIST:

A checklist is a type of informational job aid used to reduce failure by compensating for potential limits of human memory and attention. It helps to ensure consistency and completeness in carrying out a task. A basic example is ‗to do list'. A more advanced checklist lays out tasks to be done according to the time of a day or other factors.

The checklist consists of a list of items with a place to check or to mark yes or no.

Purpose :

The main purpose of the checklist is to call attention to various aspects of an object or situation, to see that nothing of importance is overlooked. For Example, if you have to go on an outing for a week, you have to list what things you have to take with you. Before leaving home, if you will check your baggage with the least there will be less chance of forgetting to take any important things, like toothbrushes, etc. it ensures the completeness of details of the data. Responses to the checklist items are largely a matter of fact, not of judgment. It is an important tool in gathering facts for educational surveys.

Uses: Checklists are used for various purposes. As we have discussed that we can check our requirements for the journey, Birthday list, proforma for pass-port, submitting examination form or admission form, etc. in every case, if we will check before doing the work, then there is less chance of overlooking any, important things. As it is useful in over daily life, it is also useful in the educational field in the following way.

- To collect acts for educational surveys.
- To record behaviour in observational studies.
- To use in the educational appraisal, studies – of school buildings, property, plan, textbooks, instructional procedures and outcomes, etc.
- To rate the personality.

Hints on Constructing Checklist :

- Items in the checklist may be continuous or divided into groups of related items.
- Items should be arranged in categories and the categories in a logical or psychological order.
- Terms used in the items should be clearly defined.
- The checklist should be continuous and comprehensive.

- A pilot study should be taken to make it standardized.
- The checklist can be constructed in four different ways by arranging items differently.

(1) In one of the arrangements all items found in a situation are to be checked. For Example, a subject may be asked to check ( ) on the blank side of each activity undertaken in a school.

(2) In the second form, the respondent is asked to check with a _yes' or _no' or asked to encircle or underline the response to the given item. For Example, (1) Does your school have a house system? Yes/No

(3) In this form, all the items are positive statements with checks ( ) to be marked in a column of a right. For Example, (1) The school functions as a community center ( ).

(4) The periodical tests are held – fortnightly, monthly, quarterly, regularly.

The investigator has to select any one of the formats appropriate to his problem and queries or the combination of many as it requires.

Analysis and Interpretation of Checklist Data :

The tabulation and quantification of checklist data are done from the responses. Frequencies are counted, percentages and averages calculated, central tendencies, measures of variability, and co-efficient of correlation completed as and when necessary. In long checklists, where related items are grouped category-wise, the checks are added up to give total scores for the category wise total scores can be compared between themselves or with similar scores secured through other studies.

The conclusions from checklist data should be arrived at careful ad judiciously keeping in view the limitations of the tools and respondents.

Merits :

- Students can measure their behaviour with the help of a checklist.
- Easy and simple to use and frame the tools.
- Wanted and unwanted behaviours can be included.
- Personal - Social development can be checked.

Limitations :

- Only the presence or absence of the ability can be tested.
- Yes or no type judgment can only be given.
- How much can not be tested through the checklist?

PSYCHOLOGICAL TESTS:

Among the most useful and most frequently employed tools of educational research psychological tests occupy a very significant position. Psychological tests are described to

describe and measure a sample of certain aspects of human behaviour or inner qualities. They yield objective descriptions of some psychological aspects of an individual‘s personality and translate them into quantitative terms. As we have mentioned earlier there are various kinds of psychological tests. In this unit, we will discuss _Aptitude tests‘ and _Inventories‘.

Aptitude Tests :

Aptitude tests attempt to predict the capacities or the degree of achievement that may be expected from individuals in a particular activity.

Aptitude is a means by which one can find the relative knowledge of a person in terms of his intelligence and also his knowledge in general.

Purpose :

The purpose of an aptitude test is to test a candidate ‘s profile. An aptitude test helps to check one ‘s knowledge and filters the good candidates. The ability of creativity and intelligence is proved by the aptitude test. It always checks the intelligence and fastness of the person in performance.

Importance of Aptitude Test :

Research data show that individually administered aptitude tests have the following qualities:

- They are excellent predictors of future scholastic achievement.
- They provide ways for comparison of a child‘s performance with others in the same situation.
- They provide a profile of strengths and weaknesses.
- They asses difference among individuals.

Uses Of Aptitude Test:

Aptitude tests are valuable in making program and curricula decisions. In general, they have three major uses:

Instructional: Teachers can use aptitude test results to adopt their curricula to match the level of students or to design assignments for students who differ widely.

Administrative: The result of Aptitude tests help in determining the programmes for college based on the aptitude level of high school. It can also identify students to be accelerated or given extra attention, for exampling and in predicting job training performance.

Guidance: the result of aptitude tests helps counselors to help parents and students. Parents develop realistic expectations for their Child ‘s performance and students understand their strengths and weaknesses.

Intelligence tests are also a kind of aptitude test as they describe and measure the general ability which enters into the performance of every activity and thus predict the degree of achievement that may be expected from individuals in various activities.

Aptitude tests, however, have proved of great value for research in educational and vocational guidance, for research in the selection of candidates for a particular course of study or professional training, and research of the complex causal relationship type.

INVENTORY :

Inventory is a list, record, or catalog containing a list of traits, preferences, attitudes, interests, or abilities used to evaluate personal characteristics or skills.

The purpose of the inventory is to make a list about a specific trait, activity, or program and to check to what extent the presence of that ability types of Inventories like

- Internet Inventory and
- Personality Inventory

Interest Inventory:

Persons differ in their interests, likes, and dislikes. Internets are a significant element in the personality pattern of individuals and play an important role in their educational and professional careers. The tools used for describing and measuring the interests of individuals are the internet inventories or interest blanks. They are self-report instruments in which the individuals note their likes and dislikes. They are of the nature of standardized interviews in which the subject gives an introspective report of his feelings about certain situations and phenomena which is then interpreted in terms of the internets.

The use of interest inventories is most frequent in the areas of educational and vocational guidance and case studies. Distinctive patterns of interest that go with success have been discovered through research in several educational and vocational fields. Mechanical, computational, scientific, artifice, literary, musical, social service, clerical, and many other areas of interest have been analyzed informs of activities. In terms of specific activities, a person‘s likes and dislikes are sorted into various interest areas and percentile scores are calculated for each area. The area where a person‘s percentile scores are relatively higher is considered to be the area of his greatest interests, the area in which he would be the happiest and the most successful.

As a part of educational surveys of many kinds, children‘s interest in reading, in games, in dramatics, in other extracurricular activities and curricular work, etc. are studied.

One kind of instrument, most commonly used in interest measurement is known as Strong's Vocational Interest Inventory. It compares the subject's pattern of interest to the interest patterns of successful individuals in several vocational fields. This inventory consists of 400 different items. The subject has to tick mark one of the alternatives i. e. L(for like), I(indifference), or D(Dislike) provided against each item. When the inventory is standardized, the scoring keys and percentile norms are prepared based on the responses of a fairly large number of successful individuals of a particular vocation. A separate scoring key is therefore prepared for each separate vocation or subject area. The subject's responses are scored with the scoring key of a particular vocation to know his interest or lack of interest or lack of interest in the vocation concerned. Similarly, his responses can be scored with scoring keys standardized for other vocational areas. In this way, you can determine one's areas of vocational interest. Another well-known interest inventories, there are also personality inventories to measure the personality. You can prepare inventories of any ability to measure it.

OBSERVATION :

Observation offers the researcher a distinct way of collecting data. It does not rely on what people say they do, or what they say they think. It is more direct than that. Instead, it draws on the direct evidence of the eye to witness events. It is a more natural way of gathering data. Whenever direct observation is possible it is the preferable method to use.

The observation method is a technique in which the behaviour of research subjects is watched and recorded without any direct contact. It involves the systematic recording of observable phenomena or behaviour in a natural setting.

Purpose:

The purpose of observation techniques are:

- To collect data directly.
- To collect a substantial amount of data in a short period.
- To get eye witness first-hand data in real like situation.
- To collect data in a natural setting.

Characteristics:

It is necessary to make a distinction between observation as a scientific tool and the casual observation of the man in the street. Observation with the following characteristics will be scientific observation.

Observation is systematic.

- It is specific.
- It is objective.
- It is quantitative.
- The record of observation should be made immediately.
- The expert observer should observe the situation.
- Its result can be checked and verified.

Types of Observation: Based on the purpose of observation may be of varied type like:

- Structured and Unstructured
- Participant and Non-participant

Structured and Unstructured Observation :

In the early large stage of an investigation, it is necessary to allow maximum flexibility in observation to obtain a true picture of the phenomenon as a whole. In the early stage, if we attempt to restrict the observation to certain areas, then there we', be the risk of overlooking some of the more crucial aspects. As the investigator studies the significant aspects and observes some restricted aspects of the situation to derive more and rigorous generalizations. So in the first stage of observation, the observation is wide and unstructured, and as the investigation proceeds observation gets restricted and structured.

Participant and Non-Participant Observation:

In participant observation, the observer becomes more or less one of the groups under observation and shares the situation as a visiting stranger, an attentive listener, an eager learner, or as a complete participant-observer, registering, recording, and interpreting behaviour of the group.

In non-participant observation, the observer observes through one-way screens and hidden microphones. The observer remains a look from the group. He keeps his observation as inconspicuous as possible. The purpose of non-participant observation is to observe the behaviour in a natural setting. The subject will not shift his behaviour or will not be conscious that someone is observing his behaviour.

The advantages and disadvantages of the participant and non-participant observation depend largely on the situation. Participant observation is helpful to study criminals at least participating with a person sometimes. It gives a better insight into life. Therefore, it has a built-in validity test. Its disadvantages are that it is time-consuming As he develops a relationship with the members, there is a chance of losing his neutrality, objectivity, and accuracy to rate things as they are:

Non-participant observation is used with groups like infants, children, or abnormal persons. It permits the use of recording instruments and the gathering of large quantities of data. Therefore, some researchers feel that it is best for the observer to remain only a partial participant and to maintain his status as a scientific observer apart from the group.

Steps of Effective Observation:

As a research tool, effective observation needs effective

- Planning
- Execution
- Recording and
- Interpretation

Planning:

While planning to employ observation as a research technique the following factors should be taken into consideration.

- The sample to be observed should be adequate.
- Units of behaviour to be observed should be clearly defined.
- Methods of the recording should be simplified.
- Detailed instruction should be given to observes if more than one observation is employed to maintain consistency.
- Too many variables should not be observed simultaneously.
- An excessively long period of observation without a rest period should be avoided.
- Observes should be fully trained and well equipped.
- Records of observation must be comprehensive.

Execution: A good observation plan lends to success only when followed with skill and expert execution. Expert execution needs:

- Proper arrangement of special conditions for the subject.
- Assuming the proper physical position for observing.
- Focusing attention on the specific activities or units of behaviour under observation.
- Observing discreetly the length and number of periods and internals decided upon.
- Handling well the recording instruments to be used.
- Utilizing the training received in terms of expertness.

Recording:

The two common procedures for recording observations are:

- Simultaneous
- Soon after the observation

Which methods should be used depending on the nature of the group? The type of behaviour to be observed. Both the method has their merits and limitations. The simultaneous form of recording may distract the subjects while after observation the observer may distract the subjects while after observation the observer may fail to record the complete and exact information. Therefore, for a systematic collection of data the various devices of the recording should be used. They are like – checklist, rating scale, and score card, etc.

Interpretation:

Interpretation can be done directly by the observer at the time of his observation. Where several observers are involved, the problem of university is there. Therefore, in such instances, the observer merely records his observations and leaves the matter of interpretation to an export that is more likely to provide a unified frame of reference. It must, of course, be recognized that the interpreter 's frame of reference is fundamental to any interpretation and it might be advisable to insist on the agreement between interpreters of different backgrounds.

Limitations of Observation:

The limitations of observation are:

- Establishing validity is difficult.
- Subjectivity is also there.
- It is a slow and laborious process.
- It is costly both in terms of the time of time and money.
- The data may be unmanageable.
- There is the possibility of biasness

These limitations can be minimized by systematic observation as it provides a framework for the observation that all observes will use. It has the following advantages.

Advantages of Observation :

- Data collected directly
- Systematic and rigorous
- A substantial amount of data can be collected in a relatively short period.
- Provides pre-coded data and ready for analysis.
- Inter observer reliability is high.

However, observation is a scientific technique to the extent that it serves a formulated research purpose, planned systematically rather than occurring haphazardly, systematically recorded and related to more general propositions, and subjected to checks and controls concerning validity, reliability, and precision.

INTERVIEW:

Interviews are an attractive proposition for the project researcher. Interviews are something more than conversation. They involve a set of assumptions and understandings about the situation which are not normally associated with a casual conversion. Interviews are also referred to as an oral questionnaire by some people, but it is indeed much more than that. Questionnaire involves indirect data collection, whereas Interview data is collected directly from others in face-to-face contact. As you know, people are hesitant to write something than to talk. With a friendly relationship and rapport, the interviewer can obtain certain types of confidential information which might be reluctant to put in writing.

Therefore, research interviews should be systematically arranged. It does not happen by chance. The interviews were not done by a secret recording of discussions as research data. The consent of the subject is taken for the interview. The words of the interviews can be treated as _on the record 'and _for the record '. It should not be used for other purposes besides the research purpose. The discussion, therefore, is not arbitrary or at the whim of one of the parties. The agenda for the discussion is set by the researcher. It is dedicated to investigating a given topic.

Importance of Interview:

Whether it is large-scale research or small-scale research, the nature of the data collection depends on the number of resources available. The interview is particularly appropriate when the researcher wishes to collect data based on:

- Emotions, experiences, and feelings.
  Sensitive issues.
  Privileged information.
- It is appropriate when dealing with young children, illiterates, language difficulty, and limited, intelligence.
- It supplies the detail and depth needed to ensure that the questionnaire asks valid questions while preparing the questionnaire.

- It is a follow-up to a questionnaire and complements the questionnaire.
- It can be combined with other tools to corroborate facts using a different approach.
- It is one of the normative survey methods, but it is also applied in historical, experimental, case studies.

Types of Interview:

Interviews vary in purpose, nature, and scope. They may be conducted for guidance, therapeutic or research purposes. They may be confined to one individual or extended to several people. The following discussions describe several types of interviews.

Structured Interview :

A structured interview involves fight control over the format of questions and answers. It is like a questionnaire that is administered face to face with a respondent. The researcher has a predetermined list of questions. Each respondent is faced with identical questions. The choice of alternative answers is restricted to a predetermined list. This type of interview is rigidly standardized and formal.

Structured interviews are often associated with social surveys where researchers are trying to collect large volumes of data from a wide range of respondents.

Semi-Structured Interview :

In a semi-structured interview, the interviewer also has a clear list of issues to be addressed and questions to be answered. There is some flexibility in the order of the topics. This type of interviewee is given chance to develop his ideas and speak more widely on the issues raised by the researcher. The answers are open-ended and more emphasis is on the interviewee elaborating points of interest.

Unstructured Interview :

In the case of an unstructured interview, emphasis is placed on the interviewee‘s thoughts. The role of the researcher is to be as unintrusive as possible. The researcher introduces a theme or topic and then letting the interviewee develop his or her ideas and pursue his or her train of thought. Allowing interviewees to speak their minds is a better way of discovering things about complex issues. It allows in-depth investigations.

Single Interview :

This is a common form of a semi-structured or un-structured interview. It involves a meeting between one researcher and one informant. It is easy to arrange this type of interview. It helps the researcher to locate specific ideas with specific people. It is also easy to control the situation on the part of the interviewer.

Group Interview :

In the case of group interviews, more than one informant is involved. The numbers involved normally about four to six people. Here you may think that it is difficult to get people together to discuss matters on one occasion and how many voices can contribute to the discussion during any one interview. But the crucial thing to bear in mind. Here is that a group interview is not an opportunity for the researcher to questions to a sequence of individuals, taking turns around a table. _group' is crucial here, because it tells us that those present in the interview will interact with one another and that the discussion will operate at the level of the group. They can present a wide range of information and varied viewpoints.

According to Lewis

Group interviews have several advantages over individual interviews. In particular, they help to reveal consensus views, may generate richer responses by allowing participants to challenge one another's views, may be used to verify research ideas of data gained through other methods, and may enhance the reliability of responses.

The disadvantage of this type of interview is that the views of _quieter' people do not come out. Certain members may dominate the talk. The most disadvantage is that whatever opinions are expressed are acceptable by the group irrespective of their opinions contrary to it. The private opinion does not give importance.

Focus Group Interview :

This is an extremely popular form of interview technique. It consists of a small group of people, usually between six and nine in number. This is useful for non-sensitive and non-sensitive and non-controversial topics. The session usually revolves around a prompt, a trigger, some stimulus introduced by the interviewer to _focus' the discussion. The respondents are permitted to express themselves completely, but the interviewer directs the life of thought. In this case, importance is given to collective views rather than the aggregate view. It concentrates on a particular event or experience rather than on a general line of equality.

Requirements of a Good Interview :

As a tool of research good interview requires:

- Proper preparation.
- Skillful execution and
- Adequate recording and interpretation.

Preparation for Interview :

The following actors need to be determined in advance of the actual interview:

- The purpose and information needed should be clear.
- Which type of interview is best suited for the purpose should be decided.
- A clear outline and framework should be systematically prepared.
- Planning should be done for recording responses.

Execution of the Interview :

- Rapport should be established.
- Described information should be collected with a stimulating and encouraging discussion.
- The recording device should be leased without distracting the interviewee.

Recording and Interpreting Responses :

- It is best to record through a tape recorder.
- If the responses are to be noted down, they should be either noted simultaneously or immediately after it.
- Instead of recording responses, sometimes the researcher noted the evaluation directly interpreting the responses.

Advantages of Interview :

Interviews techniques have the following advantages:

Depth Information :

Interviews are particularly good at producing data that deal with topics in-depth and in detail. Subjects can be probed, issues pursued lines of investigation followed over a relatively long period.

Insights :

The researcher is likely to gain valuable insights based on the depth of the information gathered and the wisdom of —key informants.

Equipment :

Interviews require only simple equipment and build on conversation skills which researchers already have.

Information Priorities: Interviews are a good method for producing data based on the informant‘s priorities, opinions, and ideas. Informants have the opportunity to expand their ideas, explain their views and identify what regard as their crucial factors. **Flexibility :**

Interviews are more flexible as a method of data collection. During adjustments to the line of inquiry can be made.

Validity :

Direct contact at the point of the interview means that data can be checked for accuracy and relevance as they are collected.

High response rate :

Interviews are generally pre-arranged and scheduled for a convenient time and location. This ensures a relatively high response rate.

Therapeutic:

Interviews can be a rewarding experience for the informant, compared with questionnaires, observation, and experiments, there is a more personal element to the method and people end to enjoy the rather rare chance to talk about their ideas at length to a person whose purpose is to listen to ad note the ideas without being critical.

Disadvantages of Interviews :

Irrespective of the above advantages, it has the following disadvantages.

Time Consuming :

Analysis of data can be difficult and time-consuming. Data preparation and analysis is —end loaded‖ compared with, for instance, questionnaires, which are preceded and where data are ready for analysis once they have collected. The transcribing and coding of interview data is a major task for the researcher which occurs after the data have been collected.

Difficulty in data analysis :

This method produces non-standard responses. Semi-structured and unstructured interviews produce data that are not pre-coded and have a relatively open format.

Less Reliability :

Consistency and objectivity are hard to achieve. The data collected are, to an extent, unique owing to the specific content and the specific individuals involved. This hurts reliability.

Interviewer Effect :

The identity of the researcher may affect the statements of the interviewee. They may say what they do or what they prefer to do. The two may not tally.

Inhibitions :

The tape recorder or video recorder may inhibit the importance. The interview is an artificial situation where people are speaking for the record and on the record and this can be daunting for certain kinds of people.

Invasion of Privacy :

Interviewing can be an invasion of Privacy and may be upsetting for the informant.

Resources :

The cost of the interviewer's fine, of travel, and transcription can be relatively high if the informants are geographically widespread. Based on the merits and limitations of the interview techniques it is used in many ways for research and non-research purposes. This technique was used in common wealth teacher training study to know the traits must essentials for success in teaching. Apart from being an independent data collection tool, it may play an important role in the preparation of questionnaires and check lists which are to be put to extensive use.

Standardization of a tool

The first step in preparing a research tool is to develop a pool of items. This is followed by item analysis which involves computing the difficulty index and discrimination index of each item. This is followed by ascertaining the validity of the tool.

(i) Validity :

Validity is the most important consideration in the selection and use of any testing procedures. The validity of a test, or any measuring instrument, depends upon the degree of exactness with which something is reproduced/copied or with which it measures what it purports to measure. The validity of a test may be defined as "the accuracy with which a test measures what it attempts to measure." It is also defined as "The efficiency with which a test measures what it attempts to measure". Lindquist has defined validity – "As the accuracy with which it measures that which is intended to as the degree to which it approaches infallibility in measuring what it purports to measure".

Based on the preceding definitions, it is seen that

- Validity is a matter of degree. It is maybe high, moderate, or low.
- Validity is specific rather than general. A test may be valid for one specific purpose but not for another Valid for one specific group of students but not for another.

TYPES OF VALIDITY :

(i) Content Validity: According to Anastasi (1968), "content validity involves essentially the systematic examination of the text content to determine whether it

covers a representative sample of the behavior domain to be measured". It refers to how well our tool sample represents the universe of criterion behavior. Content validity is employed in the selection of items in research tools. The validation of content through competent judgments is satisfactory when the sampling of items is wide and judicious.

(ii) **Criterion-related Validity:** This is also known as empirical validity.

There are two forms of criterion-related validity.

a) Predictive Validity: It refers to how well the scores obtained on the tool predict future criterion behavior.

b) Concurrent Validity: It refers to how well the scores obtained on the tool are correlated with present criterion behavior.

(iii) Construct Validity: It is the extent to which the tool measures a theoretical construct or trait or psychological variable. It refers to how well our tool seems to measure a hypothesized trait.

FACTORS AFFECTING VALIDITY :

The following points influence the validity of a test :

(I) **Unclear Direction:** If directions do not indicate to the respondent how to respond to tool items, the validity of a tool is reduced.

(II) **Vocabulary:** If the vocabulary of the respondent is poor, he/she fails to respond to the tool item, even if he/she knows the answer. It becomes a reading comprehension text for him/her, and the validity decreases.

(III) **Difficult Sentence Construction:** If a sentence is so constructed as to be difficult to understand, respondents would be confused, which will affect the validity of the tool.

(IV) **Poorly Constructed Test Items:** These reduce the validity of a test.

(V) **Use of Inappropriate Items:** The use of inappropriate items lowers validity.

(VI) **Difficulty Level of Items:** In an achievement test, too easy or too difficult test items would not discriminate among students. Thereby the validity of a test is lowered.

(VII) **Influence of Extraneous Factors:** Extraneous factors like the style of expression, legibility, mechanics of grammar, (Spelling, punctuation) handwriting, length of the tool, influence the validity of a tool.

(VIII) **Inappropriate Time Limit:** In a speed test, if no time limit is given the result will be invalidated. In a power test, an inappropriate time limit will lower its validity.

Our tests are both power and speed tests. Hence care should be taken in fixing the time limit.

(IX) **Inappropriate Coverage:** If the does not cover all aspects of the construct being measured adequately, its content validity will be adversely affected due to inadequate sampling of items.

(X) **Inadequate Weightage:** Inadequate weightage to some dimensions, sub-topics, or objectives would call into question the validity of the tool.

(XI) **Halo Effect:** If a respondent has formed a poor impression about one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue poor on all other aspects too. Similarly, good impression about one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue high on all other aspects too. This is known as the halo-effect which lowers the validity of the tool about one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue poor on all other aspects too.

RELIABILITY :

A test score is called reliable when we have reasons for believing the score to be stable and trustworthy. If we measure a student s level of achievement, we hope that his score would be similar under different administrators, using different scores, with similar but not identical items, or during a different time of the day. The reliability of a test may be defined as-

"The degree of consistency with which the test measures what it does measure".

Anastasi (1968) "Reliability means consistency of scores obtained by the same individual when re-examined with the test on different sets of equivalent items or under other variable examining conditions". Psychological or educational measurement is indirect and is connected with less precise instruments or traits that are not always stable. There are many reasons why a pupil's test score may vary –

a) Trait Instability: The characteristics we measure may change over some time.

b) Administrative Error: Any change in direction, timing, or amount of rapport with the test administrative may cause score variability.

c) Scoring Error: Inaccuracies in scoring a test paper will affect the scores.

d) Sampling Error: Any particular questions we ask to infer a person's knowledge may affect his score.

e) Other Factors: Such as health, motivation, degree of fatigue of the pupil, good or bad luck in guessing may cause score variability.

THE METHODS OF ESTIMATING RELIABILITY: The four procedures in common use for computing the reliability coefficient of a test) Test-Retest Method b) The Alternate or Parallel Forms Method. c) The Internal Consistency Reliability d) The Inter-rater Reliability

a) Test-Retest (Repetition) Method (Co-efficient of Stability):

In .test-retest method the single form of a test is administered twice on the same sample with a reasonable gap. Thus, two set of scores are obtained by administering a test twice. The correlation Co-efficient is computed between the two set of scores as the reliability index. If the test is repeated immediately, many subjects will recall their first answers and spend their time on new material, thus tending to increase their scores. Immediate memory effects, practice and the confidence induced by familiarity with the material will affect scores when the test is taken for a second time. And, if the interval between tests is rather long, growth changes will affect the retest score and tends to lower the reliability coefficient.

A high test – retest reliability or co-efficient of stability shows that there is low variable error in the sets of obtained scores and vice-versa. The error variance contributes inversely to the coefficient of stability.

b) Alternate or Parallel forms Method (Co-efficient of Equivalence Reliability) :

When alternative or parallel forms of a test can be developed, the correlation between Form-'A' and Form 'B' may be taken as a reliability index.

The reliability index depends upon the alikeness of two forms of the test. When the two forms are virtually alike, reliability is too high, when they are not sufficient alike, reliability will be too low. The two forms of the test are administered on same sample of subjects on the same day after a considerable gap. Pearson's method of correlation is used for calculating of correlation between the sets of scores obtained by administering the two forms of the test. The co-efficient of correlation is termed as co-efficient of equivalence.

c) The Spilt Half Method (The Co-efficient of Stability and Equivalence) : The test is administered once on sample of subjects. Each individual scope is obtained in two parts (odd numbers and even numbers). The scoring is done separately of these two parts even numbers and odd numbers of items. The co-efficient of correlation is calculated of two halves of scores. The co-efficient of correlation indicates the reliability of half test. The self-correlation co-efficient of whole test is then estimated by using spearman-Brown Prophecy formula.

d) The method of 'Rational Equivalence (Co-efficient of Internal Consistency) : The method of rational equivalence stresses the inter correlations of items in the test and the correlations

of the items with the test as a whole. The assumption is that all items have the same or equal difficulty value, but not necessary the same persons solve each item correctly. **Factors Influencing Reliability:**

(i) Interval: With any method involving two setting testing occasions, the longer the interval of time between two test administration, the lower the co-efficient will tend to be.

(ii) Test Length: Adding equivalent items makes a test more reliable, while deleting them makes it less reliable. A longer test will provide amore adequate sample of the behaviour being measured and the scores are apt to be less influenced by chance factors. Lengthening of a test by a number of practical considerations like time, fatigue, boredom, limited stock of good items.

(iii) Inappropriate Time Limit: A test is considered to be a pure speed test if everyone who reaches an item gets it right, but no one has the time to finish all the items. A power test is one in which everyone has time to try all the items but, because of the difficulty level, no one obtains a perfect score.

(iv) Group Homogeneity : Other things being equal, the more heterogeneous the group, the higher the reliability. The test is more reliable when applied to a group of pupils with a wide range of ability than one with a narrow range of ability.

(v) Difficulty of the Items: Tests in which there is little variability among the scores give lower reliability estimates that tests in which the variability is high. Too difficult or too easy tests for a group will tend to be less reliable because the differences among the pupils in such tests are narrow.

(vi) Objectivity of Scoring: The more subjectively a measure is scored, the lower its reliability. Objective-type tests are more reliable than subjective/Essay type tests.

(vii) Ambiguous Wording of Items: When the questions are interpreted in different ways at different times by the same pupils, the test becomes less reliable.

(viii) Inconsistency in Test Administration: Such as deviations in timing, procedure, instructions, etc. fluctuations in interests and attention of the pupils, Shifts in emotional attitude make a test less reliable.

(ix) Optional Questions: If optional questions are given, the same pupils may not attempt the same items on a second administration, thereby the reliability of the test is reduced.

ITEM ANALYSIS:

Item analysis begins after the test is over. The responses of the examinees are to be analysed to check the effectiveness of the test items. The teacher must come to some

judgments regarding the difficulty level, discriminating power and content validity of items. Only those items which are effective are to be retained, while those which are not should either be discarded or improved. This is known as the process of item-analysis.

A test should be neither too easy nor too difficult; and each item should discriminate validity among the high and low achieving students. (i) The difficulty value of each item. (ii) The discriminating power of each item. (iii) The effectiveness of distracters in the given item.

STEPS INVOLVED IN ITEM – ANALYSIS :

The next phase is concerned with item analysis, which is the technical name for deriving each item or question for the test. One of it is difficulty level and the another one is discriminating power between the good and bad performance on the text items were analyzed in both quantitative item of their satisfied program. Quantitative analysis includes the consideration of content, validity and evaluation of items in terms of writing procedures. Then identify an upper group and a lower group. Upper group is highest scoring 27% and lower group is lowest scoring 27% For the standardization of tool, the investigator used item analysis technique,

1. First the tools were arranged in ascending order on the basis of total score obtained by the students.

2.The upper 27% of the total scores were placed in the high group and the lower 27% of the total scores were placed in the low group. From the two groups, it provides criterion groups from which to evaluate the individual items.

3.The item difficulty index was estimated using the formula

$$\text{D.I.} = U + L \,/2N$$

4.The item discriminating power estimated using the formula,

$$\text{D.P} = U - L/\, N$$

U = Number of right responses in the higher group

L = Number of right responses in the lower group

N = Total Number

The difficult index of a good item is considered of lying between the value 0.4 to 0.8 the discriminating power of the value is more than 0.4 is considered to be an ideal. An item satisfying both the above criteria is acceptable

(v) **Standardisation of a Tool**: A **tool is said to be standardized if** it is constructed according to some 1) well-defined procedure; 2) administered according to definite instructions; 3) scored according to a defined plan and 4) that it provides a statement of norms. A **tool** is standardized in respect of content; method of administration; method of scoring; and setting

up of norms. Thus, standardization is a process for refining a measuring instrument through scientific procedures.

Its steps are as follows:

1. **Preparing a draft form of the tool and writing items as per the operational definition of the tool.** Items should be selected in such a way that the expected **respondent** behaviour in different situations is reflected in the items.

2. Computing discrimination index and difficulty index (if it is a test) of the items. In other words, conducting item analysis. Through this process, item validity is established.

3. Ascertaining content validity, face validity, construct validity, and criteria validity as the case may be.

4. Ascertaining the reliability of the tool.

5. Fixing the time limit. This includes recording the time taken by different individuals at the time of the preliminary try out to fix the time limit for the final administration of the tool. It also depends upon the purpose of the tool. Time allowances must always take into consideration the age and ability of the respondents, the type of items used, and the complexity of the learning outcomes to be measured.

6. Writing the directions for administering the tool. Careful instructions for responding to different types of items and for recording responses should be given/provided. The directions should be clear, complete, and concise so that every respondent knows what he/she is expected to do. The respondent should be instructed how and where to mark the items, the time allowed, and the reduction of errors, if any, to be made in scoring. Instructions for scoring are to be given in the test manual.

7. Preparing a scoring key. To ensure objectivity in scoring, the scoring should be done in a pre-determined manner. In quantitative research, the scoring key is prepared in advance.

8. Establishing norms. Computing the norms (age-wise, gender-wise, grade-wise, urban-rural location-wise, and so on). Norms provide the user with a standardized tool with the basis for a practical interpretation and application of the results. A respondent's score can be interpreted only by comparing it with the scores obtained by similar respondents. In the process of standardization, the tool must be administered to a large, representative sample for whom it is designed.

9. Preparing the manual of the tool. Every standardized tool should be accompanied by the tool manual. The purpose of the manual is to explain what the tool is supposed to measure, how it was constructed, how it should be administered and scored, and how the results should be interpreted and used. It should also explain the nature of the sample selected, the

number of cases in the sample, and the procedure of obtaining the norms. The manual should display the weaknesses as well as the strengths of the tool and should provide examples of ways in which the tool can be used as well as warnings concerning limitations and possible misuse of the results.

UNIT - II

MIXED METHOD AND ACTION RESEARCH

Meaning- Purpose- Types of Mixed methods design - Key Characteristics of Mixed Method designs- Steps in conducting a mixed methods study - Values added in 51 conducting mixed method research - challenges in conducting the mixed mode research. Action Research : Meaning and definition – Purpose - Types : individual, collaborative, school wide and district wide - Key Characteristics of Action Research- Steps in conducting Action Research.

MIXED METHODS DESIGN

Mixed Method Design

If research has access to both quantitative and qualitative data, they can use both forms of data to understand their research problem and answer their research question. With qualitative research now accepted by educational researchers, and with quantitative research long established as an approach, mixed methods research has become popular as the newest development in research methods and in approaches to "mixing" quantitative and qualitative research.

Meaning of mixed methods research

A mixed methods research design is a procedure for collecting, and analyzing, and a "mixing both quantitative and qualitative methods in a single study or a series of studies to understand a research problem. The basic assumption is that the uses of both quantitative and qualitative methods, in combination, provide a better understanding of the research problem and question then either method by itself. If researcher uses this design, researcher needs to understand both quantitative and qualitative research. This makes this type of design an advanced methods procedure. The procedures are time

consuming, requiring extensive data collection and analysis, and such time requirements may require that researcher participate in a researcher team when using it. Also, mixed methods research is not simply collecting two distinct "strands" of research qualitative and quantitative. It consists of merging, integrating, linking, or embedding the two "strands". In short, the date are "mixed" in a mixed methods study.

Purpose of a mixed methods study

There are several reasons for using a mixed methods design to conduct a study. In general, researcher conduct a mixed methods study when researcher have both quantitative and qualitative data and both types of data, together, provide a better understanding of their research problem than either type by itself. Mixed methods research is a good design to use if a researcher seeks to build on the strengths of both quantitative and qualitative data. Quantitative data, such as scores on instruments, yield specific numbers that can be statistically analysed, can produce results to access the frequency and magnitude of trends, and can provide useful information if researcher need to describe trends about a large number of people. However, qualitative data, such as open-ended interviews that provide actual words of people in the study, offer many different perspectives on the study topic and provide a complex picture of this situation.

Researcher also conducts a mixed methods study when one type of research (qualitative or quantitative) is not enough to address the research problem or answer the research questions. More data is needed to extend, elaborate on, or explain the first database. For example, researcher may want to first explore the data qualitatively to develop and instrument or to identify variables to test in a later quantitative study. Researcher engage in a mixed

methods study when researcher want to follow up a quantitative study with a qualitative one to obtain more detailed, specific information than can be gained from the results of statistical tests. Researcher use mixed-methods when researcher wants to provide an alternative perspective in a study. An example of this would be an experimental study in which the experiment yields useful information about outcomes, but the additional collection of qualitative data develops a more in-depth understanding of how the experimental intervention actually worked. Another example would be when a policy maker wants both the "numbers" and the "stories" about an issue. These different sources of information provide both a condensed understanding of a problem as well as the detail. On a practical level, researcher use mixed methods research for studies in graduate programs in which qualitative research has yet to be fully accepted and in which quantitative approaches are the norm. Although individuals in these programs may recognise the value of qualitative research, a mixed methods study is more acceptable than a "pure" qualitative study because there is still a component of quantitative research in the study. Also on a practical level, mixed-methods studies are increasingly being published in the scholarly literature. Graduate students use mixed methods research in order to learn and experience this form of research design so that they are well informed about the latest research approaches.

The types of mixed methods design

Although work has begin on identifying types of mixed methods designs, many models and approaches have been advanced in the literature. The strategy authors have taken is to review published studies and classify them by type of design. Before examining the types of designs, it might be helpful to reflect on useful strategies for identifying a mixed methods study reported in

the published literature. One strategy is to ask the following questions to help researcher identify a study as mixed methods research.

- **Is there evidence in the title?** Loot at the title to determine if it includes words such as quantitative and qualitative, mixed methods, or other related terms to signify the collection of both quantitative and qualitative data. Related terms might be integrated, combined, triangulation, multimethod, or mixed methodology.
- **Is there evidence in the data collections section?** Examine the "Methods" or "Procedure" section where the author addresses data collection and identify if researches discuss forms of quantitative data (that is a numbers reported) and the qualitative data (that is words or images) as part of the data collection.
- **Is there evidence in the purpose statement or the research questions?** Examine the abstract or the introduction of the study to identify the purpose or research questions. **Do these statements indicate that the researcher intends to collect to both quantitative and qualitative data during this study?**

Using these 4 questions, a researcher can locate and identify most mixed methods designs commonly used in educational research. There are 6 mixed methods designs, with the first 4 as the basic designs in use today and the last two as complex designs that are becoming increasingly popular (Creswell and Plano Clack, 2011).

The designs are

- The convergent parallel design
- The explanatory sequential design
- The exploratory sequential design

- The embedded design
- The transformative design
- Multiphase design

THE CONVERGENT PARALLEL DESIGN

The purpose of a convergent (or parallel or concurrent) mixed methods design is to simultaneously collect both quantitative and qualitative data, merge the data, and use the results to understand a research problem. A basic rationale for this design is that one data collection form supplies strengths to offset the weaknesses of the other form, and that a more complete understanding of a search problem results from collecting both quantitative and qualitative data. For example, quantitative scores on an instrument from many individuals provide strengths to offset the weaknesses of qualitative documents from a few people. Alternatively, qualitative, in depth observation of a few people offers strength to quantitative data that does not adequately provide detailed information about the context in which individuals provide information. How does the process of a convergent study work? The researcher gathers both quantitative and qualitative data, analysis both datasets separately, compares the results from the analysis of both datasets and makes an interpretation as to whether the results support or contradict each other. The direct comparison of the two datasets by the researcher provides a "convergence" of data sources.

THE EXPLANATORY SEQUENTIAL DESIGN

Instead of collecting data at the same time and merging the results, a mixed methods researcher might collect quantitative and qualitative information sequentially in two phases, with one form of data collection following and informing the other. An explanatory sequential mixed methods

design consists of first collecting quantitative data and then collecting qualitative data to help explain or elaborate on the quantitative results. The rationale for this approach is that the quantitative data and results provide a general picture of the research problem more analysis, specifically through qualitative data collection, is needed to refine, extent, or explain the general picture.

This edition has the advantage of clearly identified quantitative and qualitative parts, an advantage for readers as well as for those designing and conducting the study. Unlike the convergent design, the researcher does not have to converge or integrate two different forms of data. This design also captures the best of both quantitative and qualitative data to obtain quantitative results from a population in the first phase, and then refine or elaborate these findings through an indepth qualitative exploration in the second phase. The difficulty in using this design, however, is that the researcher needs to determine what aspect of the quantitative results to follow up on. This follow up means a deciding on the participants to sample in the second qualitative phase as well as the questions to ask in this follow-up phase that builds on the initial quantitative phase. Also, this design is labor intensive, and it requires both expertise and time to collect both quantitative and qualitative data.

THE EXPLORATORY SEQUENTIAL DESIGN

Rather than first analysing or collecting quantitative data as is done in the explanatory design, the mixed methods researcher begins with qualitative data and then collect quantitative information. The purpose of an exploratory sequential mixed-methods design involves the procedure of first gathering qualitative data to explore a phenomenon and then collecting quantitative data to explain relationships found in the qualitative data. A popular application of this design is to explore a phenomenon, identify themes, design and instrument,

and subsequently test it. Researches use this design when existing instruments, variables, and the measures may not be known or available for the population under study.

THE EMBEDDED DESIGN

A second form of mixed methods design is similar to both the parallel and the sequential design, with some important differences. The purpose of the embedded design is to collect quantitative and qualitative data simultaneously or sequentially, but to have one form of data play a supportive role to the other form of data. The reason for collecting the second form of data is that it augments or supports the primary form of data.

The supportive data may be either qualitative or quantitative, but most examples in the literature support adding qualitative data into a quantitative design. For example, during a quantitative experiment, the researcher may collect the qualitative data to examine how participants in the treatment condition are experiencing the intervention. Also, the researcher may collect qualitative data either before or after the experiment to help support the experimental study. Collecting data before the experiment can help to design an intervention that is tailored to the participants. Collecting data after the experiment can help to explain and follow up on the quantitative outcome results. As another example, during a correlational study, the researcher may gather secondary qualitative data to help understand the reasons for the correlational results. In some embedded designs, the procedures are sequential, with the secondary form of data gathered before the experiment begins after it concludes.

How does the process of an embedded study work? The researcher collects both quantitative and qualitative data during a single study, the two

datasets are analysed separately, and they address different research questions. For example, the quantitative data will address whether the intervention had an impact on the outcomes,whereas the qualitative data will assess how the participants experienced the intervention.

THE TRANSFORMATIVE DESIGN

At a more complex level than the 4 previous designs, we have the transformative mixed-methods design. The intent of the transformative mixed methods design is to use one of the four designs, but to encase the design within a transformative framework or lens. This framework provides an orienting lens for the mixed methods design. It informs the overall purpose of the study, the research questions, the data collection, and the outcome of the study. The intent of the framework is to address a social issue for a marginalised or underrepresented population and engage in research that brings about change. Thus, strength of this design is that it is value based and ideological. The typical frameworks found in mixed methods are feminist, racial, ethnic, disability, and gay or lesbian perspectives. A challenge in using this design is that we are still learning about how to best integrate the framework into a mixed method study.

MULTIPHASE DESIGN

Like the transformative design, the multiphase design in a complex design that builds on the basic convergent, explanatory, exploratory, and embedded designs. **Multiphase mixed method designs** occur when researchers or a team of researchers examine a problem or topic through a series of phases or separate studies. The groups of phases or studies are considered to be a mixed methods design and the intent of the design is to address a set of incremental research questions that all advance one programmatic research

objective. The phases or studies may employ a combination of concurrent or sequential design and this form of design is popular in large-scale health research and in evaluation research. The strength of this design lies in the use of multiple projects to best understand an overall program objective. Challenges include forming a research team that can work comfortably together given diverse method orientations, making sure that the phases or studies link together, and having all of the studies provide insight into an overall project objective.

THE KEY CHARACTERISTICS OF MIXED METHOD DESIGN

Mixed method designs can be distinguished from other types of design in several ways. In reviewing the following six characteristics, consider incorporating them into their plan for a study if researcher intend to conduct a mixed methods study. Also, look for them in a mixed methods study researcher might be reviewing or reading. They are:

- Provide a rationale for the design
- Include collecting quantitative and qualitative data
- Consider priority
- Consider sequence
- Match the data analysis is to a design
- Diagram the procedures

Provide Rationale for the Design

Reader and those who review mixed methods studies need to know why researcher is mixed method. Mixed methods researcher include a justification or rationale for the use of both quantitative and qualitative data. One justification is that collecting data in a second phase is important to test the qualitative exploration of the first phase of the study.

Alternatively, a reason for conducting a mixed methods study might be that researcher seek to explain in more detail through qualitative research the initial quantitative statistical results (i.e., explanatory design) or one from of data plays a supporting role to the other database (i.e., embedded design). Another justification results from combining the "best" of both quantitative and qualitative research (i.e., convergent design). Quantitative provides the opportunity to gather data from a large number of people and generalize result, whereas qualitative permits an in-depth exploration of a few individuals. Whatever the rationale, mention this rationale early in a study, such as in the introduction.

Include collecting quantitative and Qualitative Data

Include any mixed methods study, researcher should clearly indicate that researcher is collecting both quantitative and qualitative data. Methods of data collection are typically associated with either numbers or numerical data and words or text and image data. Mixed methods researchers collect both quantitative and qualitative data.

Consider Priority

Mixed methods researchers often advance a priority for the collection of qualitative and quantitative data. Three options are available to the researcher for prioritizing data:

- Quantitative and qualitative data are of equal weight
- Quantitative data is of greater weight than qualitative data.
- Qualitative data is of greater weight than quantitative data.

Priority means that in a mixed methods design, the researcher place more emphasis on one type of data than on other types of data in the research and the writer report. This emphasis may result from personal experience with data

collection, the need to understand one form data before proceeding to the next, or the audience reading the research. Whatever the reason, in examining a mixed methods study for priority, ask the following question:

- What do researcher emphasize more in the purpose statement-exploration or prediction of outcomes?
- Which data collection process-quantitative or qualitative-do researchers give the most attention to (e.g., number of pages in a report) in the "Result" section?
- Which data collection process do researchers examine in the most depth?

Consider Sequence

Mixed methods researchers advance the sequence of data collection using concurrent or sequential approaches or some combination. Again, several options exist for the sequencing of data collection.

- Researcher collects both quantitative and qualitative data at the same time.
- Researcher collects quantitative data first, followed by qualitative data.
- Researcher collects qualitative data first, followed by quantitative data.
- Researcher collects both quantitative and qualitative at the same time as well as in sequence.

If the purpose of the study is to explain quantitative results further with qualitative data (i.e., explanatory design) or to develop an instrument from qualitative data (i.e., exploratory design), the procedures should clearly indicate this sequence. The data collection procedures are independent of each other and typically presented as phases. If the intent of the study is to converge the findings (i.e., convergent design), then the data are collected at the same

time, and the researcher is explicit about this process. This process involves two data collection efforts that proceed simultaneously and are related to each other. Some mixed methods studies involve both the concurrent and the sequential processes of data collection.

Match the Data Analysis to a Design

One of the most difficult challenges for the mixed methods researcher is how to analyses data collected from qualitative and quantitative research.

This is more than simply being able to link or intersect data and numbers, although this connection does present some challenges. Several authors have begun the discussion about data analysis in mixed methods research. To examine options for data analysis, reflect back on the type of design and the options for analysis within each design. This list is not comprehensive and should not limit the creative potential of a mixed methods researchers; it is largely to focus the discussion and present typical analytic procedures discussed by writers and illustrated in mixed methods studies.

Convergent design analysis

Of all of the designs, this analysis is perhaps the most difficult and controversial. The standard approach seems to converge or compare in some way quantitative data (e.g., scores) and qualitative data (e.g., text). One way is to provide a discussion in a side by-side analysis about the them emerging from the data and how they support or refute the statistical analysis. In a study conducted about controversial art on College campus (e.g., a painting or novel), the researcher might collect questionnaires from campus constitutions as well as interview date from administrators, faculty, and students. The researcher might then compare the two Sources of data to determine if the interviews supported the questionnaire results.

Another approach is to combine the qualitative and quantitative data to arrive at new variables or new themes for further testing or exploration. In the controversial art case, the interview data and questionnaires' scores combine to produce a new variable, such as the sensitivity of campus constitutions to some forms of art. This variable becomes information for further exploration.

Some mixed methods researchers quantify qualitative data to compare the data directly with statistical results. For instance, researcher could reduce interview data from campus personnel to themes and make counts of the occurrences of each them. Researcher could compare the frequency of these themes with the descriptive statistics about information from scales. Alternatively, the researcher might analyze the questionnaires, develope thems (or scales) that reflect issues surrounding campus art , and compare the themes to those generated by campus personal during the qualitative interviews.

A final approach is to directly compare quantitative results and the qualitative findings in a table, a joint display. This, was one of the analytic procedures used by Lee and Greene (2007) in which they arrayed quotes that showed both convergent and divergent findings from their quantitative data.

Explanatory Design Analysis

Because researcher collect data in distinct phases, the analysis of an explanatory design is easier to see and conduct than in a convergent design. A popular approach is to collect quantitative data and look for extreme cases to follow up in a qualitative phase. In a mixed methods study about the transition of adults from school to work, Blustein et al. (1997) first conducted a quantitative correlational analysis of transition measures (i.e., job satisfaction and congruence) and then employed the results to provide an "in-depth and

focused approach to analyze the corresponding qualitative narratives". Specifically, they identified individuals with high and low scores (i.e., extreme cases) on the dependent measures and then conducted a qualitative, thematic analysis using interviews with these
individuals.

Exploratory Design Analysis

In this design, the substantial qualitative data collection becomes a means for developing or locating quantitative instruments; forming categorical information for later quantitative data collection; or developing generalizations from a few initial qualitative cases. Perhaps, the most popular use is to generate an instrument well grounded in the qualitative data from participants in a study. In the case of a researcher who studied first - year teachers in reservation - based, Native American elementary schools, the existing instruments were not sensitive enough to identify the cultural factors that affected this first - year experience.

Embedded Design Analysis

In the embedded design analysis, the analyses of the quantitative and qualitative data are kept separate because the two datasets often reflect different questions. Thus, in an experiment, the outcome analysis is conducted for the quantitative data and the process qualitative data is analyses for them. In an embedded design for a correlational study, the analyses also proceed independently of each other. In both the experimental and the correlational examples, results of the two databases can be interpreted together - how one reinforce the other or complements the other. When a sequential design is used with the embedded design, researchers will use one form of analysis to inform the quantitative phase or qualitative phase of the study.

Diagram the Procedures

Mixed methods researchers often provide a visualization or diagram of their design depicting the procedures. It consists of labelling the quantitative and qualitative data, indicating the sequence of activities (using arrows or plus signs), and emphasizing the priority (using lowercase or uppercase letters). By including this visualization, the researcher helps readers identify the sequence of data collection, an important aid when collecting multiple forms of data.

STEPS IN CONDUCTING MIXED METHODS STUDY

Step1. Determine if a Mixed Methods Study is Feasible

The audiences such as graduate committees, publishers, other researchers, and practitioners in educational settings will appreciate the complexity of their mixed methods study.

Step 2. Identify a Rationale for Mixing Methods

Assuming that a study is feasible, researchers needs to consider why researcher is collecting both quantitative and qualitative data. The rationale for the four designs should provide a good starting point. Be explicit in this rationale, and include it early in their research plan or report. See the reasons for conducting mixed methods studies advanced earlier in this chapter.

Step 3. Identify a Data Collection Strategy

Identifying their rationale for the study will lead to planning their procedures for collecting data. Researcher need to know:

- The priority researcher will give to quantitative and qualitative data.
- The sequence of their data collection, if researcher do not plan to collect the data concurrently
- The specific forms of quantitative data (e.g.' attendance records) and qualitative data (e.g; pictures) researcher will collect.

Step 4. Develop Quantitative, Qualitative, and Mixed Methods Questions

With the specific design in mind, next develop their research questions. Depending on the type of design, researcher can identify these questions prior to a study or they may emerge during the study. For instance, in a two-phase design, the questions for their second phase cannot be specifically identified early in the study-they will emerge as the study progresses. Alternatively, for a convergent design, researcher can present the questions before data collection and specify them in detail.

Step 5. Collect Quantitative and Qualitative Data

Collecting data in a mixed methods study follows rigorous quantitative procedures and persuasive qualitative procedures. For a mixed methods study, the sequence in which researcher collect the data will depend on the type od design. However, in all designs, this phase of the research will be lengthy and requires god organization of the information. Statistical programs and text analysis programs can provide useful systems for storing, managing, and recording the data.

Step 6. Analyze Data Separately, Concurrently, or Both

The data analysis will also relate to the specific type of mixed methods designs researcher is using. Researcher can analyse quantitative data separately from qualitative data, as in the explanatory and exploratory designs, or integrate the date analysis, as in the convergent design.

Step 7. Write the Report as a One- or Two- Phase Study or a Multiple-Phase Study

The final step in a mixed study is to write a scholarly report of the project. Some variations are seen in the writing structure of mixed methods studies, as outlined here:

- The report is written in two phases. The report contains one section to specify the problem and the literature. Then, the sections of data collection, analysis, and interpretation, two-phases-one quantitative and one qualitative – are used for each section.
- The report integrates the quantitative and qualitative phases of the study in each section. The problem statement, for example, contains a need to explore (qualitative) and to predict or explain outcomes (quantitative). The research questions are posed as both quantitative and qualitative questions and the data collection is in one section displaying an integration of quantitative and qualitative forms. The data analysis is an attempt to converge the two databases, and researcher form the results and interpretation into problem. This structure results in a convergent design.

EVALUATE A MIXED METHODS STUDY

As a form of qualitative and quantitative research, mixed methods research needs to be consistent criteria for a good qualitative and quantitative study. In addition, there are specific aspects that people reading, evaluating, and conducting a study might consider. In a high-quality mixed methods study, the researcher (Plano Clark & Creswell, 2010):

- Describes those mixed methods is the best approach to answer the research questions because neither qualitative nor quantitative is adequate as an approach.
- Incorporates both qualitative and quantitative data collection and analysis.
- Explicitly combines or mixes the two datasets.

- Uses rigorous quantitative and persuasive qualitative procedures of data collection and analysis.
- Frames the study within one of the mixed methods research designs.
- Provides a diagram of the procedures to clarify the timing, priority, and mixing within the study.
- Signals to the reader that the study is using mixed methods (e.g., in the title, purpose statement, and methods sections) to indicate their awareness of this research design.

ACTION RESEARCH

WHAT IS ACTION RESEARCH?

A teacher is an important person in the life of data students and can help them to become better human beings. Therefore, it becomes all the more important for him to keep improving the teaching process and practices for the all round development of your students. There is one such tool in the hands of teachers about which we hear quite often in education i.e. action research. Researchers have defined the term "action research" differently. In this unit, we will discuss the meaning of action research. In order to understand the meaning of the action research, let us first understand, from where the term has originated. The history of the concept of action research can be traced back to the early works of John Dewey in the 1920s but the idea of using research in a "natural" setting can be also linked to Kurt Lewin, a social psychologist in 1940s in the United States. But the credit of using the action research in the education goes to Stephen Corey and others at Teachers College of Columbia University in 1949. Corey observed 'the need for teachers and researchers to work together improve the practices

rather than reading about what someone else has discovered of his teaching'. As a teacher of you think about your role in the classroom, you will find yourself as a knowledge disseminator, solving problems of your students and also providing your students a better learning environment. But, what happens when you come across the problem of discipline in your class? Then, your role will change to an inquirer who is capable to bring changes in the classroom environment leading to better learning. You can make changes in your classroom, if you use action research. Therefore, it is important to you as a teacher to be familiar with these practices. In this unit, you will be familiarized with the concept of the action research and how to carry out action research in your classrooms. But, before starting you must understand that this type of research is not very rigorous or difficult and time consuming. Action research is an approach that can empower you to over come problems and innovative in tackling the problems of access, enrolment, retention and learning among your students relating to your day to day classroom activities.

MEANING OF ACTION RESEARCH

You would agree that when teachers find answers to the problems in their school or classrooms then their decisions bring about improvement and positive changes with school environment. Teachers are generally interested in making their profession productive by developing all round personality of their students. All their activities in and around school focus on the achievement of this objective. For this they attempt to make teaching-learning process more interesting and attractive. By undertaking various activities in the school, the teachers try to know how effective they are through many direct or indirect sources. The identification of deficiencies by the teachers and their desire to

improve help them to perform better and better. This type of systematic effort by the teachers by reflecting on their own practices and making needed changes is called 'Action Research'. While undertaking the action research a teacher may work alone on his own specific problem. For example if a language teacher may find a pronunciation problem in his/her class, then problem is specific which needs immediate solution by the teacher. It is also possible to work collaborately on the same problem with the support and guidance from his colleagues, administrators, university scholars, and others. At times, whole school may decide to undertake a school-wide study to address a common issue, or join with others to look at district-wide issue. This will be discussed later in this unit. By, now it may be noted that action research can be undertaken individually or with the help of others.

Thus, action research is defined as a collaborative activity among colleagues who are searching for solutions to everyday, real problems such as low attendance in the classroom, poor reading habits among the students mostly experienced in their schools. Action research allows a teacher to deal with the problems practically aspect in order to address those concerns, which can exhibit some influence and make change. Suppose a teacher tries a new activity in the class to help students understand a concept they are being taught. After the class the teacher reflects on how well the activity helped the students' understanding of the concept. On the basis of feed back, the teacher modifies the activity for the next time so as to make it more effective. Therefore, action research helps a teacher to become the practitioner of the knowledge to improve instruction and increase student achievement.

Stephen Corey (1953) defined action research as the process through which practitioners study their problems scientifically in order to guide, correct

and evaluate their decisions and actions. In the educational setting i.e. school, the practitioners are the teachers and his other colleagues who work to improve instruction. Thus, action research is very much a needed component for the quality education and is not separate activity beyond his duties.

Borg (1965) has also emphasized that teachers should be aware of their problems in their own classrooms and get involved in this solutions for the improvement of teaching – learning and evaluation processes. This is through, action research the teachers examine their own educational practices systematically and carefully, using the techniques of research. When we say it is systematic and scientific, it means there are some logical steps to be followed while conducting action research. Action research helps a teacher or a practitioner to perceive understand and assess a problem in a class or school, and they help in working out a desirable solution. It is diagnostic and remedial. Action research can be used for improving local school practices, and for teacher growth and professional improvement. It is a decision oriented research in which the researcher is the same person as the practitioner who will make and live with decisions.

Who are involved in Action research?

It has been highlighted in the earlier discussions that action research can be useful for all those practitioners who are interested to improve their practices. Therefore, action research can be conducted by: 1. Workers in community development 2. Practitioners in any field who wish to improve their own practices 3. Teachers in the school setting who wish to improve instruction and motivate learners 4. Researchers who wish to conduct the applied research for solving local specific problems.

Practitioners in educational set up could be classroom teachers, heads (headmasters or principals) of schools, block education officers, district education officers, inspectors of schools or teacher educators. These functionaries may be interested to bring change for improvement in those operational areas where they has any functional responsibility. For example, teachers are expected to interact with students in classrooms in a planned way to bring desirable changes in their behaviour (cognitive, affective and psycho meter). Teachers help students to learn identified competencies in the subjects like mathematics and languages. In the non-formal and distance education mode, instructors/counselors are expected to understand the needs of the distance learners and provide those functional competencies with which they can face problems in a social set-up. A block education officer may be interested to bring certain amount of change in the form of enhanced achievement in a village primary school. He may introduce some interventions (through some programmes) with the help of teachers.

How Action Research differs?

Whenever one has to understand the concept, it is important to find the commonalities and differences with the existing data. Keeping this in mind, in the following section, we will discuss the difference between action research and other researches and how action research differs from everyday actions.

Difference between action research and other researches

The difference between action research and other researches is in emphasis, not in the method or spirit. However, there is a need to understand how dies it differs from other researchers. Action research is the research undertake practitioners so that they may improve their practices. It has most

of the characteristics of fundamental or applied research. But its methodology is not a rigorous as that of fundamental or applied research. The findings of action research are evaluated in terms of local applicability. The application of findings is 'here' and 'now'. Action research is not a library project in which you learn about a particular topic by collecting information from either the books available in the library or by using the Internet. For example, if you want to undertake a project about finding out the 'life during the Indus valley civilization', then you would go to the library, collect the relevant data and write the report in the narrative form. Action research also does not aim at finding solution to the problem in the sense of trying to find out what is wrong, but rather its aim is to suggest the measures about how to improve one's own situation.

Action research is not just doing research on or about people, but it aims at finding all available information on a topic of immediate concern so as to arrive at correct answers. For example, when you as a teacher face indiscipline problem in your classroom, you may come across a lot of studies conducted on improving the discipline problems but those results cannot be applied to your situation of specific nature as they have been conducted in different situations. Therefore, in action research, people work to improve their skills, techniques, and strategies for applying them in their own situation by understanding their own needs. Since, while conducting the action research, a practitioner is solving his/her own problem, the results cannot be generalized i.e. can't be used in the others situation, which makes it different from other researches. But in action research we follow the same systematic methodology as is used in all other researches. This means that in action research the same steps as in the other researches are followed which include identification and

statement of the problem, statement of objectives, data collection, analysis and interpretation of data and finally writing the report of the study. These steps will be discussed in detail in the proceeding part of the unit.

Difference between action research and everyday actions

If we say that the action research is not as rigorous as other researches then it does not mean that action research is just an everyday activity. Kemmis and McTaggart (1992) distinguished action research from every day actions of the teachers in the following manner:

- It is not the usual thinking when you think about your teaching i.e. what are you going to teach in your class or which teaching aids should be used? Rather, action research is more systematic and collaborative in collecting evidence on which to base rigorous group reflection about the problem faced by the teacher in the classroom.
- Action research also involves problem posing, not just problem solving.
- Action research is not research done on other people. It is research by particular people on their own work, to help them to improve what they do, including how they work with and for others.

Characteristics of action research:

Action research has the following characteristics:

- It enhances the competencies of the practitioners. Action research enables them to have a clear vision of the problematic situation, which is helpful in identifying ways and means to tackle the problem.
- It is collaborative, i.e. everyone's view is taken as a contribution in understanding the situation. Moreover, if a problem is faced by a

practitioner in a particular situation (say a school), action research can be collaborative where practitioners facing similar problems in nearby schools can collaborate to find solutions of a problem.

- Action research seeks to understand particular complex social situations whether it is a class, school or community.
- It requires reflective critique, which is a process of becoming aware of our own perceptual biases and own practices.
- Action research seeks to improve the quality of human relationships.
- It is a systematic and scientific process but not very rigorous.
- Action research allows us to identify remedial measures for improvement. It is specific in nature, i.e. specific to a particular class, school or situation. Therefore, results cannot be generalized.
- Action research helps a teacher to bring about desired changes on specific aspects of their curriculum and in their transactional strategies.
- It helps in the professional development of the teachers by enabling them to engage in intellectual pursuits and become continuous learners.
- Action research helps in systems planning and restructuring. For example, if a primary teacher finds that in his/her class the students are not able to concentrate. The teacher starts finding the reasons for the same. After, analyzing the situation, the teacher finds that the classroom window is open towards in the playground and hence most of the children often observe the other children playing in the playground and so they not able to concentrate in their studies in the class. Now, what do you think a teacher should do? Well, in such a case a teacher can change the seating plan of the classroom. This a way a teacher gets involved in restructuring the class.

- Action research is a small-scale intervention. Its objective is to bring out changes in the functioning of the practitioner himself/herself. It may or may not have applicability for others. Action research is narrowly focused research undertaken by teachers and other practitioners in a given specific situation and context.
- "Contextual nature" is an important characteristics of action research. For example, a teacher of a particular school may face a particular problem in the form errors committed by third grade students' multiplication in a school but the same problem may not be observed by him/her in other schools.
- In action research, teachers make use of quantitative and qualitative methodologies to know their students well, interact with them, observe them, and collect relevant data for analysis and interpretation.

Types of Action Research

It has been discussed in the introduction of this unit that there could be involvement of one or many participant (s) in the conduct of action research. A plan of action research can involve a single teacher investigating an issue in his or her classroom, a group of teachers working on a common problem, or a team of teachers and others focusing on a school- or district-wide issue. Therefore, based upon the nature and focus of the problem, action research may take any one of the following types:

Individual Action Research

As the name suggests the focus would be on a single issue in the classroom. For example, any teacher may be seeking solutions to various problems of classroom management, such as discipline, students' involvement instructional

strategies, use of materials, or student learning in his own classroom. These problems can be addressed on an individual basis but the teacher may have to seek support of the school administrators or external agencies. The teacher collects data either quantitatively or qualitatively or both. The results after analyzing and interpreting the data lead the teacher to implement changes in the classroom at his own level which determine the success and usefulness of the research in improving the area of focus in the classroom.

Major drawbacks of the individual research are:

Results may not be shared with others unless a teacher / practitioner makes formal presentation of his research findings at a faculty meeting or publish them in a journal or newsletter. 2. It is possible for several teachers working concurrently on the same problem with no knowledge of the work of others.

School-Wide Action Research

The school wide action research focuses on issues, which are common to all i.e. teachers, principle of the concerned school. Since the problem is common, a team of staff members work together to help each other. The members of the research team may vary from as few as two people to several teachers and administrators working with parents and students. This type of research is more in-depth than individual teacher research, since it investigates different dimensions or aspects of a research problem. The team would collaboratively narrow down the research question, gather and analyze the data, and decide on a plan of action. You might be thinking that in individual action research also, you can take help from your colleagues then what is the difference in two approaches. The difference lies in the

nature of the approach. In an individual action research, the problem is individualistic in nature but in the school-wide action research the problem is school based. For example, a school may be concerned about the lack of parental involvement in school activities. Team members including teachers, administrators will make contributions to develop a process to involve parents in the school. Here, when the problem is solved, there will be a sense of ownership and involvement in the results, which would be owned collect by all the team members.

District-Wide Action Research

As the area of the research increases the focus of the problem chosen also becomes wider in nature. The resources utilized in such type of the research are far more complex. The issues chosen are based on the organization or community. In a district wide action research a problem may be common to several schools or one organizational management. For example, a district may be facing the problem of high drop out rate in the primary schools. Since the number of schools and number of people involved are large, the data collection from all participants requires more time and great effort. The main advantage of such research is that it can bring real school reform based on a common understanding through inquiry. Because of involvement large number of people in this research, there is a genuine stake holding of the results.

Steps in conducting Action Research

As it has been discussed earlier that action research is a systematic process for finding the solution of the problem. It can be conducted either by you individually alone or you can collaborate with others. In order to carry out

the research plan, you need to understand following steps which are involved in the process:

Identification of the Problem Area and Developing a Focus:

As a teacher you may have several questions, which you wish to investigate such as poor reading ability in your students, pronunciation problem among your students, effective monitoring of the various programs and many more. Therefore, the focus of action research is on what students are experiencing or have experienced? For example, a teacher can study how to improve problem-solving skills in mathematics among the students or increase reading ability among students; or to improve the quality of student writing. It will become very difficult for you, if you select your problem, which is very vast. Therefore, it important to choose the problem which is meaningful and limit the same so that can be solved in the stipulated time of your daily work. It may be noted that careful planning at this first stage will limit false starts and frustrations. The need for action research is a result of perceived dissatisfaction with an existing situation. It is followed with the idea of bringing out improvement in the situation. The focus is on the following: (i) what is the cause of problem? (ii) Why is it happening? (iii) As a practitioner or teacher, what can I do about it? (iv) What steps can I take to solve the problem? The answers to all such questions are helpful in perceiving a problem as it exists which is a pre-requisite for undertaking any action research problem.

Formulating the problem

Once, the problem is identified, the next step is to formulate it. The practitioner tries to find causes underlying that problem along with various issues that are related to causes. These probable causes need to be stated in

concise and unambiguous terms. At this stage the practitioner also need to identify and spell out various factors and suggest possible strategies with which the problem can be solved in an effective way.

Stating the Research Questions and Development of Propositions

After formulating the problem, the practitioner need to state the research questions and develop a tentative theory in the form of propositions keeping in view the genesis of the problem. It is necessary to develop a conceptual and functional relationships, tentatively to understand and explain the given situation. This step is helpful in facilitating the conduct of action research.

Data Collection

The collection of data is the most important step in deciding what action is needed for solving the problem. In the school, there could be multiple sources of data, which a practitioner can use to identify causes and developing, and implementation remediation measures. The sources that a practitioner can use for collecting various data are under:

Videotapes and audio tapes • Report cards, • Attendance, samples of student work, projects, performances • Interviews with he parents, students etc • Cumulative records and Anecdotal records • School Diaries • Photos • Questionnaires • Focus groups discussions • Checklists • Observation schedules

Select the data that are most appropriate for the study. But, use at least three sources of data for making the basis for actions; this process is called data triangulation. Data triangulation allows developing comprehensive perspective about the knowledge and understanding of the learner and the learning

environment. By using multiple sources, we can strengthen the clarity and depth of our understanding while we minimize the weaknesses of any single source. After collecting the data, these are arranged on the basis of gender, classroom, grade level, school, etc. The practitioner may use purposive samples of students or teachers from each grade level in case of larger groups.

Analysis and Interpretation of Data

After the data has been gathered, the next step is to analyze the data in order to identify trends and themes. The qualitative data obtained on the basis of the interviews taken, or from the cumulative records of the students, opinions, attitudes, or checklists can be reviewed to take out the common elements or themes and may be summarized in the suitable table formats. The quantitative data can be analyzed with the use of simple statistics such as percentages, simple frequency tables, or by calculating simple, descriptive statistics. A teacher can also take the assistance from the technical staff. Thus, the information from these analyses directs immediate and long-term action and allows determining if there are group differences among learners in the school (i.e. gender, race/ethnicity, socioeconomic, etc.).

At this step, the data is turned into information, which can help the practitioner or the faculty in making decisions. Therefore, this stage requires maximum time. A teacher either discusses the analysis with his/her colleagues to determine priority area(s) for action; and to decide what can be done or he/she can do at his/her own level. After the analysis, it becomes clear that what important points do these data reveal and which important patterns or trends are emerging.

Discussions and Evaluating Actions

After the careful analysis of the data review of current literature is done for taking decisions and necessary actions. Following points should be kept in mind while conducting the literature review: i. Identifying topics that relate to the area of the study and would most likely yield useful information. ii. Gather or collect research reports, research, books and videotapes relating to the problem. iii. Organise these materials for drawing inferences in the light of result of the action research study. iv. Determine the most promising actions schools can employ for improving classroom and school practices.

Suggesting a plan of action that will allow the practitioner to make a change. This is well informed decision – making. The actions/innovations selected ultimately improves student learning. Also, a practitioner may select one to three innovative strategies focusing primarily on the improvement of instruction, curriculum and the administrative set up that need to be integrated for the improved health of the organization. For example, after the careful analysis a practitioner may find the ways to control the indiscipline in his class which include: changing the teaching style, by encouraging more student's participation, by becoming more audible to the students etc. Here, it may be noted that there are many suggestive actions but it is important to mention that if several changes are made at once, it will be difficult to determine which action is responsible for better outcome. Hence it is advisable to suggest one action at a time and then observe its outcome in improving the situation. A practitioner will get report on each action, which he/she has taken but to choose one of thee the practitioner has to judge the better action on the basis of the effects of the intervention and improvement that has occurred. If there is improvement, do the data clearly provide the supporting evidence? If no,

then think further about what changes can be made to the actions to elicit better results.

Uses of Action Research

Action Research can be a worthwhile pursuit for educators for a number of reasons. Foremost among these is simply the desire to know more. Good teachers are, after all, themselves students, and often look for ways to update their existing knowledge. Let us discuss some benefits of action research.

1. Professional development

Action Research influences thinking skills, level of efficacy, willingness to share and communicate, and attitudes toward the process of change. Through, action research teachers learn about themselves, their students, their colleagues, and can determine ways to continually improve.

Interactions and sharing of thoughts

Through, action research the teachers team up together that allows them to talk with others about teaching and teaching strategies. During their discussions the teachers describe their own teaching styles and strategies and share their thoughts with others, which in turn develops a stronger relationships. It is through action research, we see increased sharing and collaboration across departments, disciplines, grade levels, and schools.

Potential to Impact School Change

Most researches are often criticized that one away from the ground realities. When teachers conduct action research, they look at questions that mostly address school and district contexts and concerns. This develops better communication, and sharing among the teachers and thus teachers learns from

their own and others experiences, which can create a positive impact on the school culture.

Reflect on own Practice

Action research provide a chance to practitioners to evaluate themselves in schools in an informal manner. It is conducted to investigate what effects their teaching have on the students learning, how they could work better with other teachers, on the whole how can they work to change the whole school for the better.

Improved Communications

Teamwork within the school or district brings individuals together for a shared purpose. Educators involved in action research become more flexible in their thinking and more open to new ideas (Pine, 1981). Studies by Little (1981) suggest that interactions and sharing of information bring positive changes in patterns of collegiality, communication, and networking.

UNIT - III

COLLECTING, ANALYZING, INTERPRETING QUANTITATIVE AND QUALITATIVE DATA

Quantitative Data: Administering the data collected - Steps in the process of quantitative data analysis - Preparing master chart - Analyzing the data: Descriptive analysis and inferential analysis - Preparing and interpreting the results. Qualitative Data: Types of qualitative data to be collected: Observation, Interview, Documents, Audio-Visual materials - Procedures to be used to record data - Steps in analyzing, interpreting qualitative data: Organizing data, transcribing data, coding the data, using codes and themes - Representing and reporting findings, summarizing findings. Mixed Method Data: Data analysing methods: inductive, deductive, writing theoretical notes, Quantification, Shaping metaphors, Critical methods: testing the findings and communicative validation.

Qualitative data collection is more than simply deciding on whether researcher will observe or interview people. Five steps comprise the process of collecting qualitative data. Researcher need to identify their participants and sites, gain access, determine the types of data to collect, develop data collection forms, and administer the process in an ethical manner.

THE STEPS IN THE PROCESS OF QUALITATIVE DATA COLLECTION

There are five interrelated steps in the process of qualitative data collection. These steps should not be seen as linear approaches, but often one step in the process does follow another. The five steps are first to identify participants and sites to be studied and to engage in a sampling strategy that will best help researcher understand their central phenomenon and the research question researcher are asking. Second, the next phase is to gain access to these individuals and sites by obtaining permissions. Third, once permissions are in place, researcher need to consider what types of information will best answer their research questions. Fourth, at the same time, researcher need to design protocols or instruments for collecting and

recording the information. Finally and fifth, researcher needs to administer the data collection with special attention to potential ethical issues that may arise. Some basic differences between quantitative and qualitative data collection are helpful to know at this point. Based on the general characteristics of qualitative research, qualitative data collection consists of collecting data using forms with general, emerging questions to permit the participant to generate responses; gathering word (text) or image (picture) data; and collecting information from a small number of individuals or sites. Thinking more specifically now,

- In quantitative research, we systematically identify our participants and sites through random sampling; in qualitative research, researcher identify our participants and sites on purposeful sampling, based on places and people that can best help us understand our central phenomenon.
- In both quantitative and qualitative research, researcher need permissions to begin our study, but in qualitative research, researcher needs greater access to the site because researcher will typically go to the site and interview people or observe them. This process requires a greater level of participation from the site than does the quantitative research process.
- In both approaches, researcher collects data such as interviews, observations, and documents. In qualitative research, our approach relies on general interviews or observations so that researcher does not restrict the views of participants. Researcher will not use someone else's instrument as in quantitative research and gather closed-ended information; researcher will instead collect data with a few open-ended questions that we design.
- In both approaches, researcher needs to record the information supplied by the participants. Rather than using predesigned instruments from someone else or instruments that researcher design, in qualitative research researcher will record information on self-designed protocols that help us organize information reported by participants to each question.

- Finally, researcher will administer our procedures of qualitative data collection with sensitivity to the challenges and ethical issues of gathering information face-to-face and often in people's homes or workplaces. Studying people in their own environment creates challenges for the qualitative researcher that may not be present in quantitative research when investigators mail out anonymous questionnaires or bring individuals into the experimental laboratory.

DIFFERENT SAMPLING APPROACHES

In qualitative inquiry, the intent is not to generalize to a population, but to develop an in-depth exploration of a central phenomenon. Thus, to best understand this phenomenon, the qualitative researcher purposefully or intentionally selects individuals and sites. This distinction between quantitative "random sampling" and qualitative "purposeful sampling".

In quantitative research, the focus is on randu n sampling, selecting representative individuals, and then generalizing from these individuals to a population. Often this process results in testing "theories" that explain the population. However, in qualitative research, researcher select people or sites that can best help researcher understand the central phenomenon. This understanding emerges through a detailed understanding of the people or site. It can lead to information that allows individuals to "learn" about the phenomenon, or to an understanding that provides voice to individuals who may not be heard otherwise.

Purposeful Sampling

The research term used for qualitative sampling is purposeful sampling. In purposeful sampling, researchers intentionally select individuals and sites to learn or understand the central phenomenon. The standard used in choosing participants and sites is whether they are "information rich". In any given qualitative study, researcher may decide to study a site (e.g., one college campus), several sites (three small liberal arts campuses), individuals or groups (freshman students), or some combination (two liberal arts

campuses and several freshman students on those campuses). Purposeful sampling thus applies to both individuals and sites.

Maximal Variation Sampling

One characteristic of qualitative research is to present multiple perspectives of individuals to represent the complexity of our world. Thus, one sampling strategy is to build that complexity into the research when sampling participants or sites. Maximal variation sampling is a purposeful sampling strategy in which the researcher samples cases or individuals that differ on some characteristic or trait (e.g., different age groups). This procedure requires that researcher identify the characteristic and then find sites or individuals that display different dimensions of that characteristic. For example, a researcher might first identify the characteristic of racial composition of high schools, and then purposefully sample three high schools that differ on this characteristic, such as a primarily Hispanic high school, a predominantly white high school, and a racially diverse high school.

Extreme Case Sampling

Sometimes researcher is more interested in learning about a case that is particularly troublesome or enlightening, or a case that is noticeable for its success or failure. Extreme case sampling is a form of purposeful sampling in which researcher study an outlier case or one that displays extreme characteristics. Researchers identify these cases by locating persons or organizations that others have cited for achievements or distinguishing characteristics. An autistic education program in elementary education that has received awards may be an outstanding case to purposefully sample.

Typical Sampling

Some research questions address "What is normal?" or "What is typical?" Typical sampling is a form of purposeful sampling in which the researcher studies a person or site that is "typical" to those unfamiliar with the situation. What constitutes typical, of course, is open to interpretation. However, researcher might ask persons at a research site or even select a

typical case by collecting demographic data or survey data about all cases. Researcher could study a typical faculty member at a small liberal arts college because that individual has worked at the institution for 20 years and has embodied the cultural norms of the school.

Theory or Concept Sampling

Researcher might select individuals or sites because they help researcher understand a concept or a theory. Theory or concept sampling is a purposeful sampling strategy in which the researcher samples individuals or sites because they can help the researcher generate or discover a theory or specific concepts within the theory. To use this method, researcher need a clear understanding of the concept or larger theory expected to emerge during the research. In a study of five sites that have experienced distance education, for example, researcher have chosen these sites because study of them can help generate a theory of student attitudes toward distance learning.

Homogeneous Sampling

Researcher might select certain sites or people because they possess a similar trait or characteristic. In homogeneous sampling the researcher purposefully samples individuals or sites based on membership in a subgroup that has defining characteristics. To use this procedure, researcher needs to identify the characteristics and find individuals or sites that possess it. For example, in a rural community, all parents who have children in school participate in a parent program. Researcher chooses members of this parent program to study because they belong to a common subgroup in the community.

Critical Sampling

Sometimes individuals or research sites represent the central phenomenon in dramatic terms (Patton, 1990). The sampling strategy here is to study a critical sample because it is an exceptional case and the researcher can learn much about the phenomenon. For example, researcher

studies teenage violence in a high school where a student with a gun threatened a teacher. This situation represents a dramatic incident that portrays the extent to which some adolescents may engage in school violence.

Opportunistic Sampling

After data collection begins, researcher may find that researcher needs to collect new information to best answer their research questions. Opportunistic sampling is purposeful sampling undertaken after the research begins, to take advantage of unfolding events that will help answer research questions. In this process, the sample emerges during the inquiry. Researchers need to be cautious about engaging in this form of sampling because it might divert attention away from the original aims of the research. However, it captures the developing or emerging nature of qualitative research nicely and can lead to novel ideas and surprising findings. For example, researcher begins a study with maximal variation sampling of different pregnant teenagers in high schools. During this process researcher find a pregnant teenager who plans to bring her baby to school each day. Because a study of this teenager would provide new insights about balancing children and school, researcher study her activities during her pregnancy at the school and in the months after the birth of her child.

Snowball Sampling

In certain research situations, researcher may not know the best people to study because of the unfamiliarity of the topic or the complexity of events. As in quantitative research, qualitative snowball sampling is a form of purposeful sampling that typically proceeds after a study begins and occurs when the researcher asks participants to recommend other individuals to be sampled. Researchers may pose this request as a question during an interview or through informal conversations with individuals at a research site.

Confirming and Disconfirming Sampling

A final form of purposeful sampling, also used after studies begin, is to sample individuals or sites to confirm or disconfirm preliminary findings. Confirming and disconfirming sampling is a purposeful strategy used during a study to follow up on specific cases to test or explore further specific findings. Although this sampling serves to verify the accuracy of the findings throughout a study, it also represents a sampling procedure used during a study. For example, researcher finds out that academic department chairs support faculty in their development as teachers by serving as mentors. After initially interviewing chairs, researcher further confirm the mentoring role by sampling and studying chairs that have received praise from faculty as "good" mentors.

Sample Size or Number of Research Sites

The number of people and sites sampled vary from one qualitative study to the next. Researcher might examine some published qualitative studies and see what numbers of sites or participants researchers used. Here are some general guidelines:

❖ It is typical in qualitative research to study a few individuals or a few cases. This is because the overall ability of a researcher to provide an in-depth picture diminishes with the addition of each new individual or site. One objective of qualitative research is to present the complexity of a site or of the information provided by individuals.

• In some cases, researcher might study a single individual or a single site. In other cases, the number may be several, ranging from 1 or 2 to 30 or 40. Because of the need to report details about each individual or site, the larger number of cases can become unwieldy and result in superficial perspectives. Moreover, collecting qualitative data and analyzing it takes considerable time, and the addition of each individual or site only lengthens that time.

Let's look at some specific examples to see how many individuals and sites were used. Qualitative researchers may collect data from single

individuals. For example, in the qualitative case study of Basil McGee, a second-year middle school science teacher, Brickhouse and Bodner (1992) explored his beliefs about science and science teaching and how his beliefs shaped classroom instruction. Elsewhere, several individuals participated in a qualitative grounded theory study. The researchers examined 20 parents of children labelled as ADHD. More extensive data collection was used in a qualitative ethnographic study of the culture of fraternity life and the exploitation and victimization of women. Rhoads (1995) conducted 12 formal interviews and 18 informal interviews, made observations, and collected numerous documents.

TYPES OF QUALITATIVE DATA TO BE COLLECTED

Another aspect of qualitative data collection is to identify the types of data that will address their research questions. Thus, it is important to become familiar with their questions and topics, and to review them prior to deciding upon the types of qualitative data that researcher will collect. In qualitative research researcher pose general, broad questions to participants and allow them to share their views relatively unconstrained by their perspective. In addition, researcher collects multiple types of information, and researcher may add new forms of data during the study to answer their questions. Further, researcher engages in extensive data collection, spending a great deal of time at the site where people work, play, or engages in the phenomenon researcher wish to study. At the site, researcher will gather detailed information to establish the complexity of the central phenomenon. Researcher can see the varied nature of qualitative forms of data when they are placed into the following categories:

- Observations
- Interviews and questionnaires
- Documents
- Audiovisual materials

Specific examples of types of data in these four categories. Variations on data collection in all four areas are emerging continuously. Most recently, videotapes, student classroom portfolios, and the use of e-mails are attracting increasing attention as forms of data. Now let's take a closer look at each of the four categories and their strengths and weaknesses.

OBSERVATIONS

When educators think about qualitative research, they often have in mind the process of collecting observational data in a specific school setting. Unquestionably, observations represent a frequently used form of data collection, with the researcher able to assume different roles in the process.

Observation is the process of gathering open-ended, firsthand information by observing people and places at a research site. As a form of data collection, observation has both advantages and disadvantages. Advantages include the opportunity to record information as it occurs in a setting, to study actual behavior, and to study individuals who have difficulty verbalizing their ideas (e.g., preschool children). Some of the disadvantages of observations are that researcher will be limited to those sites and situations where researcher can gain access, and in those sites, researcher may have difficulty developing rapport with individuals. This can occur if the individuals are unaccustomed to formal research. Observing in a setting requires good listening skills and careful attention to visual detail. It also requires management of issues such as the potential deception by people being observed and the initial awkwardness of being an "outsider" without initial personal support in a setting.

Observational Roles

Despite these potential difficulties, observation continues to be a well-accepted form of qualitative data collection. Using it requires that researcher adopt a particular role as an observer. No one role is suited for all situations; observational roles vary depending on their comfort at the site, their rapport with participants, and how best researcher can collect data to understand

the central phenomenon. Although many roles exist, researcher might consider one of three popular roles.

Role of a Participant Observer

To truly learn about a situation, researcher can become involved in activities at the research site. This offers excellent opportunities to see experiences from the views of participants. A participant observer is an observational role adopted by researchers when they take part in activities in the setting they observe. As a participant, researcher assumes the role of an "inside" observer who actually engages in activities at the study site. At the same time that researcher are participating in activities, researcher record information. This role requires seeking permission to participate in activities and assuming a comfortable role as observer in the setting. It is difficult to take notes while participating and researcher may need to wait to write down observations until after researcher has left the research site.

Role of a Nonparticipant Observer

In some situations, researcher may not be familiar enough with the site and people to participate in the activities. A nonparticipant observer is an observer who visits a site and records notes without becoming involved in the activities of the participants. The nonparticipant observer is an "outsider" who sits on the periphery or some advantageous place (e.g., the back of the classroom) to watch and record the phenomenon under study. This role requires less access than the participant role, and gatekeepers and individuals at a research site may be more comfortable with it. However, by not actively participating, researcher will remove their self from actual experiences, and the observations researcher make may not be as concrete as if researcher had participated in the activities.

Changing Observational Roles

In many observational situations, it is advantageous to shift or change roles, making it difficult to classify their role as strictly participatory or non-participatory. A changing observational role is one where researchers adapt

their role to the situation. For example, researcher might first enter a site and observe as a nonparticipant, simply needing to "look around" in the early phases of research. Then researcher slowly becomes involved as a participant. Sometimes the reverse happens, and a participant becomes a nonparticipant. However, entering a site as a nonparticipant is a frequently used approach. After a short time, when rapport is developed, researcher switches to being a participant in the setting. Engaging in both roles permits researcher to be subjectively involved in the setting as well as to see the setting more objectively. Here is an illustration in which a researcher began as a nonparticipant and changed into a participant during the process of observing:

One researcher studying the use of wireless laptop computers in a multicultural education methods class spent the first three visits to the class observing from the back row. He sought to learn the process involved in teaching the course, the instructor's interaction with students, and the instructor's overall approach to teaching. Then, on his fourth visit, students began using the laptop computers and the observer became a participant by teaming with a student who used the laptop from her desk to interact with the instructor's Web site.

The Process of Observing

As researcher just saw in the discussion of different observational roles, the qualitative inquirer engages in a process of observing, regardless of the role. This general process is outlined in the following steps:

1. Select a site to be observed that can help researcher best understand the central phenomenon. Obtain the required permissions needed to gain access to the site.

2. Ease into the site slowly by looking around; getting a general sense of the site; and taking limited notes, at least initially. Conduct brief observations at fi rst, because researcher will likely be overwhelmed with all of the activities taking place. This slow entry helps to build rapport with

individuals at the site and helps researcher assimilate the large amount of information.

3. At the site, identify who or what to observe, when to observe, and how long to observe. Gatekeepers can provide guidance as researcher makes these decisions. The practical requirements of the situation, such as the length of a class period or the duration of the activity, will limit their participation.

4. Determine, initially, their role as an observer. Select from the roles of participant or nonparticipant during their first few observations. Consider whether it would be advantageous to change roles during the process to learn best about the individuals or site. Regardless of whether researcher change roles, consider what role researcher will use and their reasons for it.

5. Conduct multiple observations over time to obtain the best understanding of the site and the individuals. Engage in broad observation at first, noting the general landscape of activities and events. As researcher become familiar with the setting, researcher can begin to narrow their observations to specific aspects (e.g., a small group of children interacting during reading time). A broad-to-narrow perspective is a useful strategy because of the amount of information available in an observation.

6. Design some means for recording notes during an observation. The data recorded during an observation are called fieldnotes. Fieldnotes are text (words) recorded by the researcher during an observation in a qualitative study. In this example, the student-observer engaged in participant observation when the instructor asked the class to spend 20 minutes observing an art object that had been brought into the classroom. This object was not familiar to the students in the class. It was from Indonesia and had a square, bamboo base and a horsehair top. It was probably used for some religious activities. This was a good object to use for an observational activity because it could not be easily recognized or described. The instructor asked students to observe the object and record fieldnotes describing the object

and reflecting on their insights, hunches, and themes that emerged during the observation. Students in the class are reacting to the object. The heading at the top of the fieldnotes records essential information about the time, place, and activities observed.

Consider what information researcher will record during an observation.

For example, this information might include portraits of the participants, the physical setting, particular events and activities, and personal reactions. In observing a classroom, for example, researcher may record activities by the teacher, the students, the interactions between the students and teacher, and the student-to-student conversations.

Record descriptive and reflective fieldnotes.

Descriptive fieldnotes record a description of the events, activities, and people (e.g., what happened). Reflective fieldnotes record personal thoughts that researchers have that relate to their insights, hunches, or broad ideas or themes that emerge during the observation (e.g., what sense researcher made of the site, people, and situation).

Make their self known, but remain unobtrusive.

During the observation, be introduced by someone if researcher is an "outsider" or new to the setting or people. Be passive, be friendly, and be respectful of the people and site.

After observing, slowly withdraw from the site.

Thank the participants and inform them of the use of the data and the availability of a summary of results when researcher complete the study.

INTERVIEW

Equally popular to observation in qualitative research is interviewing. A qualitative interview occurs when researchers sk one or more participants general, open-ended questions and record their answers. The researcher then transcribes and types he data into a computer file for analysis.

In qualitative research, researcher asks open-ended questions so that the participants can best voice their experiences unconstrained by any perspectives of the researcher or past research findings. An open-ended response to a question allows the participant to create the options for responding. For example, in a qualitative interview of athletes in high schools, researcher might ask, "How does researcher balance participation in athletics with their schoolwork?" The athlete then creates a response to this question without being forced into response possibilities. The researcher often audiotapes the conversation and transcribes the information into words for analysis.

Interviews in qualitative research have both advantages and disadvantages. Some advantages are that they provide useful information when researcher cannot directly observe participants, and they permit participants to describe detailed personal information. Compared to the observer, the interviewer also has better control over the types of information received, because the interviewer can ask specific questions to elicit this information. Some disadvantages are that interviews provide only information "filtered" through the views of the interviewers. Also, similar to observations, interview data may be deceptive and provide the perspective the interviewee wants the researcher to hear. Another disadvantage is that the presence of the researcher may affect how the interviewee responds. Interviewee responses also may not be articulate, perceptive, or clear. In addition, equipment issues may be a problem, and researcher needs to organize recording and transcribing equipment in advance of the interview. Also during the interview, researcher needs to give some attention to the conversation with the participants. This attention may require saying little, handling emotional outbursts, and using icebreakers to encourage individuals to talk. With all of these issues to balance, it is little wonder inexperienced researchers express surprise about the difficulty of conducting interviews.

Types of Interviews and Open-Ended Questions on Questionnaires

Once researcher decides to collect qualitative interviews, researcher next considers what form of interviewing will best help researcher understand the central phenomenon and answer the questions in their study. There are a number of approaches to interviewing and using open-ended questions on questionnaires. Few interview approaches to use will ultimately depend on the accessibility of individuals, the cost, and the amount of time available.

One-on-One Interviews The most time-consuming and costly approach is to conduct individual interviews. A popular approach in educational research, the one-on-one interview is a data collection process in which the researcher asks questions to and records answers from only one participant in the study at a time. In a qualitative project, researcher may use several one-on-one interviews. One-on-one interviews are ideal for interviewing participants who are not hesitant to speak, who are articulate, and who can share ideas comfortably.

Focus Group Interviews Focus groups can be used to collect shared understanding from several individuals as well as to get views from specific people. A focus group interview is the process of collecting data through interviews with a group of people, typically four to six. The researcher asks a small number of general questions and elicits responses from all individuals in the group. Focus groups are advantageous when the interaction among interviewees will likely yield the best information and when interviewees are similar to and cooperative with each other. They are also useful when the time to collect information is limited and individuals are hesitant to provide information. When conducting a focus group interview, encourage all participants to talk and to take their turns talking. A focus group can be challenging for the interviewer who lacks control over the interview discussion.

Telephone Interviews

It may not be possible for researcher to gather groups of individuals for an interview or to visit one-on-one with single individuals. The participants in a study may be geographically dispersed and unable to come to a central location for an interview. In this situation, researcher can conduct telephone interviews. Conducting a telephone interview is the process of gathering data using the telephone and asking a small number of general questions. A telephone interview requires that the researcher use a telephone adaptor that plugs into both the phone and a tape recorder for a clear recording of the interview. One drawback of this kind of interviewing is that the researcher does not have direct contact with the participant. This causes limited communication that may affect the researcher's ability to understand the interviewee's perceptions of the phenomenon. Also, the process may involve substantial costs for telephone expenses.

E-Mail Interviews

Another type of interview useful in collecting qualitative data quickly from a geographically dispersed group of people. E-mail interviews consist of collecting open-ended data through interviews with individuals using computers and the Internet to do so. If researcher can obtain e-mail lists or addresses, this form of interviewing provides rapid access to large numbers of people and a detailed, rich text database for qualitative analysis. It can also promote a conversation between their self as the researcher and the participants, so that through follow-up conversations, researcher can extend their understanding of the topic or central phenomenon being studied.

Open-Ended Questions on Questionnaires

On questionnaires, researcher may ask some questions that are closed ended and some that are open ended. The advantage of this type of questioning is that their predetermined closed-ended responses can net useful information to support theories and concepts in the literature. The open-ended responses, however, permit researcher to explore reasons for the closed-ended responses and identify any comments people might have

that are beyond the responses to the closed-ended questions. The drawback of this approach is that researcher will have many responses—some short and some long—to analyse. Also, the responses are detached from the context—the setting in which people work, play, and interact. This means that the responses may not represent a fully developed database with rich detail as is often gathered in qualitative research. To analyse open-ended responses, qualitative researchers look for overlapping themes in the open-ended data and some researchers count the number of themes or the number of times that the participants mention the themes.

Documents

A valuable source of information in qualitative research can be documents. Documents consist of public and private records that qualitative researchers obtain about a site or participants in a study, and they can include newspapers, minutes of meetings, personal journals, and letters. These sources provide valuable information in helping researchers understand central phenomena in qualitative studies. They represent public and private documents. Examples of public documents are minutes from meetings, official memos, records in the public domain, and archival material in libraries. Private documents consist of personal journals and diaries, letters, personal notes, and jottings individuals write to themselves. Materials such as e-mail comments and Web site data illustrate both public and private documents, and they represent a growing data source for qualitative researchers. Documents represent a good source for text (word) data for a qualitative study.

They provide the advantage of being in the language and words of the participants, who have usually given thoughtful attention to them. They are also ready for analysis without the necessary transcription that is required with observational or interview data. On the negative side, documents are sometimes difficult to locate and obtain. Information may not be available to the public. Information may be located in distant archives, requiring the researcher to travel, which takes time and can be expensive. Further, the

documents may be incomplete, inauthentic, or inaccurate. For example, not all minutes from school board meetings are accurate, because board members may not review them for accuracy. In personal documents such as diaries or letters, the handwriting may be hard to read, making it difficult to decipher the information.

Collecting Documents

With so much variation in the types of documents, there are many procedures for collecting them. Here are several useful guidelines for collecting documents in qualitative research:

1. Identify the types of documents that can provide useful information to answer their qualitative research questions.

2. Consider both public (e.g., school board minutes) and private documents (e.g., personal diaries) as sources of information for their research.

3. Once the documents are located, seek permission to use them from the appropriate individuals in charge of the materials.

4. If researcher asks participants to keep a journal, provide specific instructions about the procedure. These guidelines might include what topics and format to use, the length of journal entries, and the importance of writing their thoughts legibly.

5. Once researcher has permission to use documents, examine them for accuracy, completeness, and usefulness in answering the research questions in their study.

6. Record information from the documents. This process can take several forms, including taking notes about the documents or, if possible, optically scanning them so a text (or word) file is created for each document. Researcher can easily scan newspaper stories (e.g., on speeches by presidential candidates) to form a qualitative text database.

Collecting personal documents can provide a researcher with a rich source of information. For example, consider a study that used journals prepared by several women: An important source for learning about women in superintendent positions is for them to keep a personal journal or diary of their experiences. A researcher asked three women superintendents to keep a diary for 6 months and record their reactions to being a woman in their capacity of conducting official meetings comprised primarily of men.

Audio visual Materials

The final type of qualitative data to collect is visual images. Audio visual materials consist of images or sounds that researchers collect to help them understand the central phenomenon under study. Used with increasing frequency in qualitative research, images or visual materials such as photographs, videotapes, digital images, paintings and pictures, and unobtrusive measures are all sources of information for qualitative inquiry. One approach in using photography is the technique of photo elicitation. In this approach, participants are shown pictures and asked to discuss the contents. These pictures might be personal photographs or albums of historical photographs.

The advantage of using visual materials is that people easily relate to images because they are so pervasive in our society. Images provide an opportunity for the participants to share directly their perceptions of reality. Images such as videotapes and films, for example, provide extensive data about real life as people visualize it. A potential disadvantage of using images is that they are difficult to analyze because of the rich information. Also, researcher as a researcher may influence the data collected. In selecting the photo album to examine or requesting that a certain type of drawing be sketched, researcher may impose their meaning of the phenomenon on participants, rather than obtain the participants' views. When videotaping, researcher face the issues of what to tape, where to place the camera, and the need to be sensitive with camera-shy individuals.

Collecting Audio visual Materials

Despite these potential problems, visual material is becoming more popular in qualitative research, especially with recent advances in technology. The steps involved in collecting visual material are similar to the steps involved in collecting documents:

Determine what visual material can provide information to answer research questions and how that material might augment existing forms of data, such as interviews and observations.

2. Identify the visual material available and obtain permission to use it. This permission might require asking all students in a classroom, for example, to sign informed consent forms and to have their , rents sign them also.

3. Check the accuracy d authenticity of the visual material if researcher do not record it their self. One way to heck for accuracy is to contact the interview the photographer or the individuals represented in the pictures.

4. Collect the data and organize it. Researcher can opt, 'ly scan the data for easy storage and retries

To illustrate the use of visual material, look at an example in which the researcher distributed cameras to obtain photographs:

A researcher gives Polaroid cameras to 40 male and 40 female fourth graders in a science unit to record their meaning of the environment. The participants are asked to take pictures of images that represent attempts to preserve the environment our society. As a result, the researcher obtains 24 pictures ,11 each child that can be used to undersi ' how Young people look at the environment. Understandably, 'Los of squirrels au, outside pets dominate the collection of pictures in this database.

PROCEDURES TO BE USED TO RECORD DATA

An essential process in qualitative research is recording data. This process involves recording information through research protocols, administering data collection so that researcher can anticipate potential

problems in data collection, and bringing sensitivity to ethical issues that may affect the quality of the data.

Using Protocols

As already discussed, for documents and visual materials, the process of recording information may be informal (taking notes) or formal. For observations and interviews, qualitative inquirers use specially designed protocols. Data recording protocols are forms designed and used by qualitative researchers to record information during observations and interviews.

An Interview Protocol

During interviewing, it is important to have some means for structuring the interview and taking careful notes. As already mentioned, audio taping of interviews provides a detailed record of the interview. As a backup, researcher needs to take notes during the interview and have the questions ready to be asked. An interview protocol serves the purpose of reminding researcher of the questions and it provides a means for recording notes. An interview protocol is a form designed by the researcher that contains instructions for the process of the interview, the questions to be asked, and space to take notes of responses from the interviewee.

Development and Design of an Interview Protocol

To best understand the design and appearance of this form, examine the qualitative interview protocol used during a study of the campus reaction to a gunman who threatened students in a classroom.

❖ It contains a header to record essential information about the interview, statements about the purpose of the study, a reminder that participants need to sign the consent form, and a suggestion to make preliminary tests of the recording equipment. Other information researcher might include in the header would be the organization or work affiliation of the interviewees; their educational background and position; the number of

years they have been in the position; and the date, time, and location of the interview.

❖ Following this header are five brief open-ended questions that allow participants maximum flexibility for responding to the questions. The first question serves the purpose of an icebreaker, to relax the interviewees and motivate them to talk. This question should be easy to understand and cause the participants to reflect on experiences that they can easily discuss,

ANALYZING AND INTERPRETING QUALITATIVE DATA

Analysing qualitative data requires understanding how to make sense of text and images so that researcher can form answers to their research questions. In this section, researcher will learn about the six steps involved in analysing and interpreting qualitative data: preparing and organizing the data, exploring and coding the database, describing findings and forming themes, representing and reporting findings, interpreting the meaning of the findings, and validating the accuracy of the findings.

STEPS IN ANALYZING AND INTERPRETING QUALITATIVE DATA

The six steps commonly used in analysing qualitative data. These steps are not always taken in sequence, but they represent preparing and organizing the data for analysis; engaging in an initial exploration of the data through the process of coding it; using the codes to develop a more general picture of the data descriptions and themes; representing the findings through narratives and visuals; making an interpretation of the meaning of the results by reflecting personally on the impact of the findings and on the literature that might inform the findings; and finally, conducting strategies to validate the accuracy of the findings.

Researcher can visualize the first major steps in this process by examining the "bottom-up" approach to analysis. Qualitative researchers first collect data and then prepare it for data analysis. This analysis initially consists of developing a general sense of the data, and then coding description and themes about the central phenomenon. Let's look at some

of the features of this process in more detail. It is inductive in form, going from the particular or the detailed data to the general codes and themes. Keeping this in mind helps researcher understand how qualitative researchers produce broad themes or categories from diverse detailed databases. Although the initial analysis consists of subdividing the data, the final goal is to generate a larger, consolidated picture.

- It involves a simultaneous process of analysing while researcher is also collecting data. In qualitative research, the data collection and analysis are simultaneous activities. When researcher is collecting data, researcher may also be analysing other information previously collected, looking for major ideas. This procedure differs from traditional approaches in quantitative research, in which data collection occurs first, followed by data analysis.
- The phases are also iterative, meaning researcher cycle back and forth between data collection and analysis. In qualitative research, researcher might collect stories from individuals and return for more information to fill in gaps in their stories as their analysis of their stories proceeds.
- Qualitative researchers analyse their data by reading it several times and conducting an analysis each time. Each time researcher read their database, researcher develops a deeper understanding about the information supplied by their participants.
- There is no single, accepted approach to analysing qualitative data, although several guidelines exist for this process. It is an eclectic process.
- Qualitative research is "interpretive" research, in which researcher make a personal assessment as to a description that fits the situation or themes that capture the major categories of information. The interpretation that researcher make of a transcript, for example, differs from the interpretation that someone else makes. This does not mean

that their interpretation is better or more accurate; it simply means that researcher bring their own perspective to their interpretation.

RESEARCHER PREPARE AND ORGANIZE THE DATA FOR ANALYSIS

Initial preparation of the data for analysis requires organizing the vast amount of information, transferring it from spoken or written words to a typed file and making decisions about whether to analyse the data by hand or by computer.

Organize Data

At an early stage in qualitative analysis, researcher organizes data into file folders or computer files. Organization of data is critical in qualitative research because of the large amount of information gathered during a study. The extensive data that an interview yields often surprises new researchers. For example, a 30-minute interview will often result in about 20 pages of single-spaced transcription. With this sizable amount of data, the transcribing and organizing of information requires a system of organization, which could take several forms, such as:

- Developing a matrix or a table of sources that can be used to help organize the material
- Organizing the materials by type: all interviews, all observations, all documents, and all photographs or other visual materials; as an alternative, researcher might consider organizing the materials by participant, site, location, or some combination of these approaches
- Keeping duplicate copies of all forms of data

TRANSCRIBING DATA

During qualitative data collection, researcher will collect text or words through interviewing participants or by writing field notes during observations. This necessitates a need to convert these words to a computer document for analysis. Alternatively, researcher might listen to the tapes or

read their field notes to begin the process of analysis. When time is short or funds are scarce, researcher may be able to have only a few interviews or a few observational notes transcribed. The most complete procedure, however, is to have all interviews and all observational notes transcribed. As a general rule of thumb, it takes approximately 4 hours to transcribe 1 hour of tape. Hence, the process of transcription is labor intensive and researcher will need to allow adequate time for it.

Transcription is the process of converting audiotape recordings or field notes into text data. Researcher may use a transcriptionist to type their text files or researcher can transcribe the information their self. In either case, for interview data, transcriptionists need special equipment to help create the transcript. This equipment consists of a machine that enables the transcriber to start and stop tape recordings or to play them at a speed so that the transcriber can easily follow them. Here are a few more guidelines to facilitate transcription:

- ❖ Create 2-inch margins on each side of the text document so that researcher can jot down notes in the margins during data analysis.
- Leave extra space on the page between the interviewer's comments and the interviewee's comments. This enables researcher to distinguish clearly between speakers during data analysis.
- Highlight or mark in some way the questions asked by the interviewer. Researcher will not analyze their questions, but identifying them clearly indicates where one question ends and another begins. Often, researcher will analyze all answers to a single question.
- Use complete, detailed headers that contain information about the interview or observational session. Examine interview and observational protocols to see the type of content to be included in a transcription.
- Transcribe all words, and type the word "[pause]" to indicate when interviewees take a lengthy break in their comments. These pauses may provide useful information about times when interviewees cannot or will not respond to a question. Researcher can also record other actions

occurring during an interview. For example, type "[laughter]" when the interviewee laughs, "[telephone rings]" to indicate a phone call that interrupts the interview, or "[inaudible]" to mark when the transcriptionist cannot determine what is being said. As a general approach, transcribing all words will provide data that captures the details of an interview.

ANALYZE BY HAND OR COMPUTER

With the popularity of computers, researchers have a choice about whether to hand analyse data or to use a computer. The hand analysis of qualitative data means that researchers read the data, mark it by hand, and divide it into parts. Traditionally, analysing text data involves using color coding to mark parts of the text or cutting and pasting text sentences onto cards. Some qualitative researchers like to hand analyse all of their data. A hand analysis may be preferred when researcher:

- Are analysing a small database and can easily keep track of files and locate text passages
- Are not comfortable using computers or have not learned a qualitative computer software program
- Want to be close to the data and have a hands-on feel for it without the intrusion of a machine
- Have time to commit to a hand analysis, since it is a labour-intensive activity to manually sort, organize, and locate words in a text database For others with a greater interest in technology and with the time to learn a computer program, a computer analysis is ideal.

A computer analysis of qualitative data means that researchers use a qualitative computer program to facilitate the process of storing, analysing, sorting, and representing or visualizing the data. With the development of these computer programs, researcher has a choice as to whether to use hand coding or a computer analysis. Researcher might base their decision on several factors. Use a computer program when researcher:

- Are analysing a large database and need to organize and keep track of extensive information
- Are adequately trained in using the program and are comfortable using computers
- Have resources to purchase a program or can locate one to use
- Need a close inspection of every word and sentence to capture specific quotes or meanings of passages

USE OF QUALITATIVE COMPUTER PROGRAMS

Qualitative computer programs do not analyse the data for researcher. However, they do provide several convenient features that facilitate their data analysis. A qualitative data analysis computer program is a program that stores data, organizes their data, enables researcher to assign labels or codes to their data, and facilitates searching through their data and locating specific text or words.

Procedures for Using Software Programs

The general procedures for using a software program are as follows:

- Convert a word processing file into a text file or import the word processing file directly into the computer program. The word processing file will be a transcribed interview, a set of field notes, or other text, such as a scanned document.
- Select a computer program to use. This program should have the features of storing data, organizing data, assigning labels or codes, and searching the data.
- Enter a file into the program and give it a name.
- Go through the file and mark sentences or paragraphs of ideas that pertain to what the participant is saying in the text.
- Provide a code label for the blocked text. Continue this process of marking text and providing code labels for the entire text file.
- After blocking and assigning labels to text, search for all text matching each code, and print out a file of these text passages.

- Collapse these code labels into a few broad themes, or categories, and include evidence for each category.

BASIC FEATURES OF SOFTWARE PROGRAMS

Many commercial, qualitative data analysis software programs are available today. A recent review of software programs analysed their features based on eight major dimensions. The basic considerations are to find a program that is easy to use, that will accept both their text files (from transcripts) and their images (from pictures), that allows researcher to read and review text and categorize it, and that sorts and finds text or image passages easily for their qualitative report. Less frequently, researcher may be interested in merging analyses compiled by different researchers or importing or exporting their analyses to other software programs.

RESEARCHER EXPLORE AND CODE THE DATA

After researcher have organized and transcribed their data and decided whether to hand or computer analyzes it, it is time to begin data analysis. This consists of exploring the data and developing codes as first steps in analysis.

EXPLORE THE GENERAL SENSE OF THE DATA

The first step in data analysis is to explore the data. A preliminary exploratory analysis in qualitative research consists of exploring the data to obtain a general sense of the data, memoing ideas, thinking about the organization of the data, and considering whether researcher need more data.

CODE THE DATA

The further process of analysing text (or images) in qualitative research begins when researcher code the data. Coding is the process of segmenting and labeling text to form descriptions and broad themes in the data. Although there are no set guidelines for coding data, some general procedures exist.

The object of the coding process is to make sense out of text data, divide it into text or image segments, label the segments with codes, examine codes for overlap and redundancy, and collapse these codes into broad themes. Thus, this is an inductive process of narrowing data into a few themes. Also, in this process researcher will select specific data to use and disregard other data that do not specifically provide evidence for their themes.

RESEARCHER USE CODES TO BUILD DESCRIPTION AND THEMES

In a qualitative research study, researcher need to analyse the data to form answers to their research questions. This process involves examining the data in detail to describe what researcher learned, and developing themes or broad categories of ideas from the data. Describing and developing themes from the data consists of answering the major research questions and forming an in-depth understanding of the central phenomenon through description and thematic development. Not all qualitative projects include both description and themes, but all studies include at least themes. Beginning with description, we can explore what it attempts to accomplish, how researcher might use it, and how it appears in a research report.

DESCRIPTION

Because description is a detailed rendering of people, places, or events in a setting in qualitative research, it is easiest to start the analysis after the initial reading and coding of the data. In some forms of qualitative research design, such as in ethnography or in case studies, the researcher provides a considerable description of the setting. Developing detail is important, and the researcher analyzes data from all sources to build a portrait of individuals or events. In providing detailed information, description can transport the reader to a research site or help the reader visualize a person. It takes experience and practice to describe the detail in a setting. For example, examine these two illustrations and note the differences in level of detail.

Poor example: The workers built the education building with three floors.

Better example: As the education building developed, iron beams crossed and connected it together. A giant crane lifted these beams into place with a line secured tightly around each beam. A worker underneath the beam fastened it into place. As we watched, the beam tipped back and forth, leading us to wonder if the crane operator had securely fastened it. One slip and disaster would follow, but the beam landed securely in place.

THEMES

In addition to description, the use of themes is another way to analyze qualitative data. Because themes are similar codes aggregated together to form a major idea in the database, they form a core element in qualitative data analysis. Like codes, themes have labels that typically consist of no more than two to four words. Through initial data analyses, researcher may find 30 to 50 codes. In subsequent analyses, researcher reduces these codes to five to seven major themes through the process of eliminating redundancies. There are several types of themes, and authors typically identify them as follows:

- Ordinary themes: themes that a researcher might expect to find.
- Unexpected themes: themes that are surprises and not expected to surface during a study.
- Hard-to-classify themes: themes that contain ideas that do not easily fit into one theme or that overlap with several themes.
- Major and minor themes: themes that represent the major ideas and the minor, secondary ideas in a database.

LAYERING AND INTERRELATING THEMES

Researcher will see many qualitative studies that stop at reporting description and themes. However, researcher can add additional rigor and insight into their study by layering themes or interconnecting them.

LAYERING THEMES

Layering themes builds on the idea of major and minor themes but organizes the themes into layers from basic elementary themes to more sophisticated ones. Layering the analysis means representing the data using interconnected levels of themes. Researcher subsumes minor themes within major themes and includes major themes within broader themes. The entire analysis becomes more and more complex as the researcher works upward toward broader and broader levels of abstraction. The number of layers may vary from two to four or five, and recognizing these layers will help researcher understand the use of themes in layered qualitative analysis. Considering again the gunman incident study, it can be found that layering was used by the authors in this study.

INTERRELATING THEMES

A second thematic analysis approach that inter- connects the themes. Interconnecting themes means that researcher connects the themes to display a chronology or sequence of events, such as when qualitative researchers generate a theoretical and conceptual model. Here we see a sample chart used in a qualitative grounded theory study. The researchers examined the practices used by 33 academic department chairs to enhance the research of faculty in their college or university units. The authors identified numerous themes within each box in the diagram. In addition, arrows show the connection among the boxes. In this sequence, the process of enhancing faculty research performance relates to the type of faculty issue, the signs that this issue is important, the context of stages of the faculty member's career, and the larger institutional context. It also includes the specific strategies employed by the chair, and the outcomes of using that strategy. In short, this process displays an interconnected set of events or activities in the process of chairs enhancing faculty performances.

RESEARCHER REPRESENT AND REPORT FINDINGS

After researcher code the data, analyze it for description and themes, layer and interconnect themes, and report findings to their research

questions. These calls for displaying findings in tables and figures and constructing a narrative to explain what researcher have found in response to their research questions.

Representing Findings

Qualitative researchers often display their findings visually by using figures or pictures that augment the discussion. Different ways to display data are listed here:

Create a comparison table. Create a visual image of the information in the form of a comparison table or a matrix, a table that compares groups on one of the themes. In a qualitative study of the meaning of "professionalism," a researcher collected statements from both women and men teachers in a school.

- Develop a hierarchical tree diagram. This diagram visually represents themes and their interconnections so that the themes are presented in order from the broad themes to the narrow themes.
- Present figures. Figures with boxes show the connections among themes.
- Draw a map. Depict the physical laresearchert of the setting.
- Develop a demographic table. Describe personal or demographic information for each person or site in the research. In a study of the types of technology used by instructors in college classrooms, the researcher described each instructor and his or her primary delivery style in a demographic table. The six individuals studied in this qualitative study displayed different personal characteristics as well as diverse approaches to using technology. This table provides readers with various demographic information for each instructor, such as number of years teaching, gender, class level of instruction, instructional approach used in the class, and his or her primary form of technology use.

REPORTING FINDINGS

The primary form for representing and reporting findings in qualitative research is a narrative discussion. A narrative discussion is a written passage

in a qualitative study in which authors summarize, in detail, the findings from their data analysis. There is no set form for this narrative, which can vary widely from one study to another. However, it is helpful to identify some frequently used forms. Several of these forms have already been discussed, such as developing description, themes, or interconnecting themes. Others are important, too, especially in advocacy and participatory forms of qualitative inquiry, such as raising questions, challenging assumptions based on evidence supplied by participants, or reflecting on how participants changed during the research. Their decision about which form or forms to use depends on the purpose of their research and the type of data researcher has analyzed for their findings.

RESEARCHER INTERPRET FINDINGS

Interpretation involves making sense of the data, or the "lessons learned," as described by Lincoln and Guba (1985). Interpretation in qualitative research means that the researcher steps back and forms some larger meaning about the phenomenon based on personal views, comparisons with past studies, or both. Qualitative research is interpretive research, and researcher will need to make sense of the findings. Researcher will find this interpretation in a fmal section of a study under headings such as "Discussion," "Conclusions," "Interpretations," or "Implications." This section includes:

- A review of the major findings and how the research questions were answered
- Personal reflections of the researcher about the meaning of the data
- Personal views compared or contrasted with the literature
- Limitations of the study
- Suggestions for future research

SUMMARIZING FINDINGS

A typical "Discussion" section begins with a general recap of the major findings. Sometimes researcher will state each individual research question

again and provide findings for each question. The overall intent of this passage is to provide readers with an overview of the findings to complement the more detailed results in the description and theme passages.

CONVEY PERSONAL REFLECTIONS

Because qualitative researchers believe that their personal views can never be kept separate from interpretations, personal reflections about the meaning of the data are included in the research study. Researcher bases these personal interpretations on hunches, insights, and intuition. Because researcher may have been to the field and visited personally at great length with individuals, researcher are in a good position to reflect and remark on the larger meaning of the data. The two examples that follow illustrate the diversity of personal reflections found in qualitative studies.

MAKE COMPARISONS TO THE LITERATURE

Interpretation may also contain references to the literature and past studies. Similar to quantitative research, the qualitative inquirer interprets the data in view of this past research, showing how the findings may support or contradict prior studies, or both. This interpretation may compare qualitative findings with reported views of a social science concept found in the literature, or it may combine personal views with an educational or social science term or idea. In a qualitative study of sibling interaction between a Young man with Down syndrome and his three brothers, the authors Harry, Day, and Quist (1998) concluded with interpretive comments about the inclusion of "Raul" in situations outside of the family setting. They relate their own views to those in the literature:

OFFER LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Also similar to quantitative research, the qualitative researcher suggests possible limitations or weaknesses of the study and makes recommendations for future research. These limitations may address problems in data collection, unanswered questions by participants, or better selection of purposeful sampling of individuals or sites for the study.

Implications for future research may include the use of the findings for practice (e.g., classrooms, schools, or with certain people such as adults or teenagers) or the need for further research (e.g., by gathering more extensive data or by asking additional questions of participants). Researcher might also state implications for decision making, such as planning for new practices (e.g., better campus planning about how to handle violent incidents) or for the audience researcher identified in the introduction to their study.

UNIT-IV

PARAMETRIC TEST

We have already learned that representative values such as mean, median and standard deviation, when calculated directly from the population, are termed *parameters.* However, it is quite a tedious task to approach each and every element or attribute of the entire population and compute the required parameters. The best way is to select an appropriate sample, compute statistics such as mean and median for the elements of this sample and then use these computed statistics for drawing inferences and estimation about the parameters. How for these inferences and estimation are trusts worthy or significant can then be tested with the help of some appropriate tests, called *test of significance*.

When to use parametric and nonparametric tests

Parametric test like 't' and 'F' tests may be used for analysing the data which satisfy the following conditions (Seigel 1956).

1. The population from which the samples have been drawn should be normally distributed. This is known by the term assumption of normality.
2. The variables involved must have been measured in interval or ratio scale.
3. The observations must be independent. The conclusion or exclusion of any case in the sample should not unduly affect the results of the study.
4. These populations must have the same variance or, in special cases, must have a known ratio of variance. This we call homoscedasticity.

Nonparametric test is recommended in the following situations

1. When N is quite small. If the size of the sample is a small as N=5 or N= 6, the only alternative is to make use of non parametric test.
2. When assumptions like normality of the distribution of scores in the population for doubtful. In other words, where the distribution is free the variates under question need not be distributed in a certain specific way in the population. It is the characteristic of the non parametric test which enables them to be called distribution free test.
3. When the measurement of the data is available either in the form of ordinal or nominal scales. That is when it can be expressed in the form of ranks or in the shape of + signs or - signs and classifications like "good-bad".

Differences between parametric and non-parametric statistics

The parametric and non-parametric statistics differ from each other on these various levels

Level of Differences	Parametric	Non Parametric
Assumed Distribution	Normal	Any
Assumed Variance	Homogeneous	Homogenous and Heterogeneous both
Typical data	Ratio or Interval	Ordinal or Nominal
Usual Central measure	Mean	Median
Benefits	Can Draw more conclusions	Simple and less affected By extreme score

ASSUMPTIONS OF PARAMETRIC AND NON-PARAMETRIC STATISTICS

Assumptions to be met for the use of parametric tests are given below:

- Normal distribution of the dependent variable
- A certain level of measurement: Interval data
- Adequate sample size (>30 recommended per group)
- An independence of observations, except with paired data
- Observations for the dependent variable have been randomly drawn
- Equal variance among sample populations
- Hypotheses usually made about numerical values, especially the mean

Assumptions of Non-parametric Statistics test are fewer than that of the parametric tests and these are given below:

- An independence of observations, except with paired data
- Continuity of variable under study Characteristics of non-parametric techniques:
- Fewer assumptions regarding the population distribution
- Sample sizes are often less stringent
- Measurement level may be nominal or ordinal
- Independence of randomly selected observations, except when paired
- Primary focus is on the rank ordering or frequencies of data
- Hypotheses are posed regarding ranks, medians, or frequencies of data

Parametric Tests

Statistical methods which depend on the parameters of populations or probability distributions are referred to as parametric tests. Parametric tests include:

- ‘t’ test
- ‘F’ test
- ANNOVA
- ANCOVA
- MANOVA
- MANCOVA
- Correlation – pearson
- Regression: Linear and Multiple regression
- Factor analysis
- Cohen’s effect size test

‘t’-TEST (Test of Significance)

‘t’ test or test of significance of the difference between means for large independent samples (Garrett, 1969) is used to compare the means between any two groups on any of the variables.

If the ‘t’ value is below a cut-off point (depending on the degrees of freedom), the differences in means is considered not significant, and the null hypothesis is accepted. When the ‘t’ value exceeds a cut-off point, the difference is said to be significant and the null hypothesis is rejected.

The t-test is used to find the significant level of difference between two groups of populations. The t-value is calculated from the mean and standard deviation of the two groups. If the obtained value is 2.58 and above, then the significant level of difference is 0.01 and if the value lies between 1.96 and 2.58, the significant level of difference is 0.05. If the value is below 1.96, the difference is not significant at any level. The t-test is calculated using the formula.

$$t = \frac{\left|M_1 - M_2\right|}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

Where,

M_1 = Mean of the I sample

M_2 = Mean of the II sample

σ_1 = Standard Deviation of the I sample

σ_2 = Standard Deviation of the II sample

N_1 = Total number of frequency of the I sample

N_2 = Total number of frequency of the II sample

F-Ratio (ANOVA single Factor)

Analysis of Variance (ANOVA) is an extremely useful technique, for testing the difference between the means of multiple independent samples. The basic principle for ANOVA is to test the differences among the means of the samples by examining the amount of variation between the samples relative to the amount of variation between the samples. This value is compared with the 'F' value for the given degrees of freedom. If the 'F' value worked out is equal or exceeds the 'F' limit value (from tables) it indicates that there are significant differences among the sample means.

The F-test is an effective way to determine whether the means of more than two samples are too different to attribute to sampling error. It consider the following operations.

1. The sum of scores and the sum of squares of the scores are obtained.
2. The variance of the score of one composite to one composite group known as the total group variance. The formula is,

$$SS_t = \sum x^2 - (\sum x)^2 / N$$

3. The mean value of the variance of each of these group computed separately is known as the between group variance

$$SS_b = (\sum x_1)^2 / N_1 + (\sum x_2)^2 / N_2 + \ldots\ldots + (\sum x_n)^2 / N_n$$

4. Within the group sum of squares

$$SS_w = SS_t - SS_b$$

5. Computation of F-ratio

F – ratio by ANOVA single factor were calculated by dividing the groups of the scores obtained by both the groups.

$$F = \frac{M_{sb}}{M_{sw}} = \frac{SS_{b|df_1}}{SS_{w|df_2}} \text{ where}$$

M_{sb} = Mean square variance between groups

M_{sw} = Mean square variance with in the group

df_1 = Number of groups

df_2 = Total number of student number of group.

ANCOVA

ANCOVA (Analysis of Coefficient of Variation) (correlated variance)

Analysis of covariance is an extension of analysis, of variance to allow for the correlation between initial and the final scores. It is also an improvement over analysis of variance technique. Analysis of covariance is useful for experimental psychologists where for various reasons it is impossible or difficult to equate experimental and control groups at the start a situation which often obtains in actual situations or in experiments. Though analysis of covariance one is able to adjust in final or terminal scores which may allow for differences in some initial variable.

Definition of covariance

The term covariance has been defined, "Statistically the covariance may be defined as the function of two correlated factors and their analysis into corresponding parts".

Practically analysis of covariance is technique to adjust the initial schools to final scores so that net effect can be analysed. Analysis of variance technique is to analyse and test the significance difference among final scores or initials course. The final scores difference may be attributable to treatment effects, while it may be caused due to initial effect. The analysis of covariance technique adjusts the initial performance to final scores to obtain the net effects of the treatments.

Meaning and functions of analysis of variance

In the experiments of psychology and education, the final scores are used to test the effectiveness of treatments. The analysis of variance technique is used for statistical analysis. The initial performance is not considered and groups are not equated. The initial performance is included in the final scores. The difference may be due to initial performance, not due to treatments effect. Thus, the findings through analysis of variance may not be valid. The initial performance should be adjusted to final scores for obtaining the net effect of the treatments. The initial and final scores for correlated to have covariance. Thus analysis of covariance technique has to adjust the final scores.

$$C.V = \frac{\sigma}{\bar{X}} \times 100$$

where, σ = standard deviation

$\bar{X}$ = Mean Value

MANOVA

What is MANOVA?

MANOVA is a member of the General Linear Model a family of statistical procedures that are often used to quantify the strength between variables (Zientek & Thompson).

Many of the procedures in the General Linear Model are hierarchically organized, i.e., more specific procedures are often special cases of general procedures. MANOVA, specifically, is an analysis of variance (ANOVA) that has two or more dependent variables.

In an ANOVA the independent variable is a nominal variable that has two or more values, and the dependent variable is intervally or ratio scaled. The null hypothesis is that the means core on the dependent variable will be statistically equal for every group. As with any null hypothesis statistical significance testing procedure, an observed statistic is calculated and then compared to a sampling distribution. If the observed statistic is found to be a more extreme value in the sampling distribution than the critical value (as shown in Figure 1), then the null hypothesis will be rejected; otherwise, the null hypothesis is retained.

Then the null hypothesis is rejected (as would be thecase for vectors A, C, and D in Figure 2). However, if a vector does not extend into the rejection region (e.g., vector in Figure2) then the null hypothesis is retained.

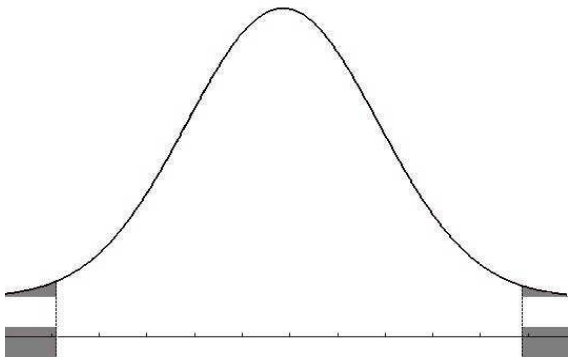
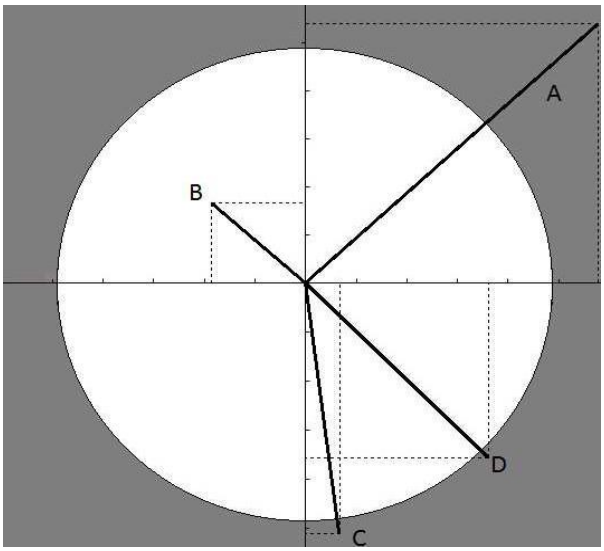


Figure1. Example of the logic of univariate hypothesis testing.

The shaded area is the rejection region. If the test statistics is in the rejection region (shown both on the histogram and on the number line below), then the null hypothesis is rejected.



Why Use MANOVA?

Figure 2 represents an ANOVA with two perfectly uncorrelated dependent variables. However, if dependent variables are correlated, then the MANOVA is better represented in Figure 3.

Although the examples in Figures2 and 3represent MANOVAs with two dependent variables, an extension to three dependent variables can be imagined without difficulty. For three perfectly uncorrelated dependent variables, the graph would be three dimensional, with the unshaded region being a reduces the likelihood of Type I error.

The probability of Type I error at least once in the series of ANOVAs (called experiment-wise error) can be as high as $1 - (1 - .05)^k$, where k is the number of ANOVAs conducted. Therefore, if are searcher chooses the traditional α value of .05 for two ANOVAs, then the experiment-wise Type I error can be as high as .0975—not .05—even though the α for each ANOVA is .05. However, the Type I error for a MANOVA on the Perfect sphere. As the variables became more correlated, the axes would become more oblique, and the sphere would become more distorted and resemble something like a football. If two of the three dependent variables were perfectly correlated (i.e., $r = + 1$), then the graph would collapse into a two-dimensional graph like in Figure3. A MANOVA with four or more dependent variables requires more than three dimensions and axes—something that most people have difficulty imagining visually, but which a computer can easily handle mathematically.

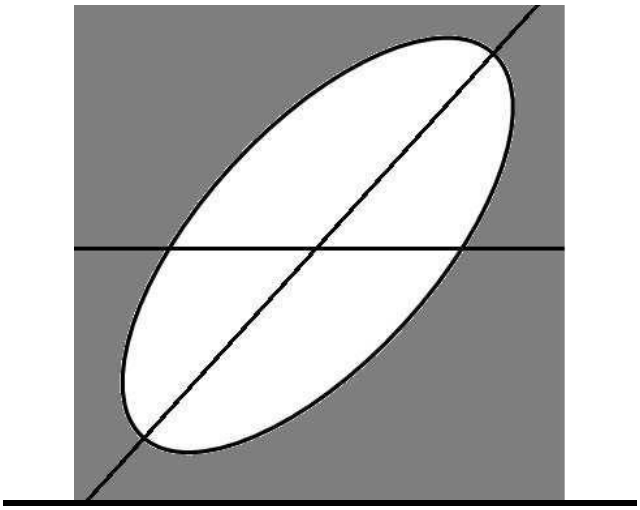


Figure3. Example of the logic of multivariate analysis of variance hypothesis testing for moderately correlated variables.

The shaded area is the rejection region.

Examining Combinations of Variables

ANOVA and MANOVA also differ in that they investigate completely different empirical questions. Zientek and Thompson (2009, p.345) explained that, *"two ANOVAs actually test the differences of the means onthe observed or measured variables . . . whereas the MANOVA actually tests the differences of the mean of the DDA function scores"* of the groups. In other words, MANOVA tests the differences between underlying un observed latent variables (derived from the variables in the dataset), while ANOVA only tests differences among groups on an observed variable. MANOVA is therefore often more useful to social scientists than ANOVA because most topics they research are latent constructs that are not directly observable, such as beliefs and attitudes. Therefore, MANOVA is a statistical procedure that is more inaccordance than ANOVA with behavioral scientists' beliefs about the topics they study.

Post Hoc Procedures

Post hoc procedures are often necessary after the null hypothesis is rejected in an ANOVA. This is becausethe null hypotheses for these procedures often do not provide researchers with all the information that they desire. For example, if the null hypothesis is rejected in an ANOVA with three or more groups, then there searcher knows that at least one group mean statistically differs from at least one other group mean. However, most

researchers will be interested in learning which mean(s) differ from which other group mean(s).

ANOVA, MANOVA has post hoc procedures to determine why the null hypothesis was rejected. For MANOVA this is usually a DDA, which is a statistical procedure which creates a set of perfectly uncorrelated linear equations that together model the differences among groups in the MANOVA (Fish,1988;Stevens,2002). The benefit of having uncorrelated equations from a DDA is that each function will provide unique information about the differences among groups, and the information can be combined in an additive way for easy interpretation.

. This is because ANOVA and MANOVA were developed to answer completely different empirical questions .Indeed, Tonidandel and LeBreton (2013) explained that, *multivariate theories yield multivariate hypotheses which necessitate the use of multivariate statistics and multivariate interpretations of those statistics. By invoking univariate ANOVAs as follow-up tests to a significant MANOVA, researchers are essentially ignoring the multivariate nature of their theory and data*.

Moreover, Fish (1988) and Huberty and Morris(1989) showed that the same data can produce different results when analyzed using a MANOVA or a series of ANOVAs—a situation that could potentially be misleading to researchers who follow MANOVA with a series of post hoc ANOVAs.

CORRELATION

If two variables, say x and y vary or move together in the same or in the opposite directions they are said to be correlated or associated. Thus, correlation refers to the relationship between the variables. Generally, we find the relationship in certain types of variables.

Scatter Diagram

When different sets of data are plotted on a graph, we obtain **scatter diagrams**. A scatter diagram gives two very useful types of information. Firstly,we can observe patterns between variables that indicate whether the variables are related. Secondly, if the variables are related we can get an idea of the type of relationship that exists. The scatter diagram may exhibit different types of relationships.

Y

Y

$r < 0$

If X and Y variables move in the same direction (i.e., either both of them increase or both decrease) the relationship between them is said to be **positivecorrelation.**

On the other hand, if X and Y variables move in the opposite directions (i.e., if variable X increases and variable Y decreases or vice-versa) the relationship between them is said to be **negative correlation.**

If Y is unaffected by any change in X variable, then the relationship between them is said to be **un-correlated.**

If the amount of variations in variable X bears a constant ratio to thecorresponding amount of variations in Y, then the relationship between them issaid to be **linear-correlation,** otherwise it is **non-linear or curvilinear correlation.** Since measuring non-linear correlation for data analysis is far more complicated, we therefore, generally make an assumption that the association between two variables is of the linear type.

If the relationship is confined to two variables only, it is called **simple correlation**.

Karl Pearson's Correlation Coefficient

Karl Pearson's coefficient of correlation (r) is one of the mathematical methodsof measuring the degree of correlation between any two variables X and Y is given as:

$$r = \frac{\sum(X-\bar{X})(Y-\bar{Y})/n}{\sigma x \sigma y}$$

The simplified formulae (which are algebraic equivalent to the above formula)are:

1. $\mathbf{r = \frac{\sum xy}{\sqrt{\sum x^2}\sqrt{\sum y^2}}}$ Where, $x = x - \bar{x}$, $y = y - \bar{y}$

Note: This formula is used when $\bar{x}$ and $\bar{y}$ are integers

2. $$r = \frac{N\sum xy - \sum x \sum y}{\sqrt{[N\sum x^2 - \frac{(\sum x)^2}{N}][N\sum y^2 - \frac{(\sum y)^2}{N}]}}$$

Before we proceed to take up an illustration for measuring the degree of correlation, it is worthwhile to note some of the following important points.

i) 'r' is a dimensionless number whose numerical value lies between +1 to –1. Thevalue +1 represents a perfect positive correlation, while the value –1 represents a perfect negative correlation. The value 0 (zero) represents lack of correlation. Figure 10.1 shows a number of scatter plots with corresponding values for correlation coefficient.

ii) The coefficient of correlation is a pure number and is independent of the units of measurement of the variables.

iii) The correlation coefficient is independent of any change in the origin and scaleof X and Y values.

Example 1: Taking as an illustration, the data of advertisement expenditure (X) and sales (Y) of a company for 10 years shown in the following table, we proceed to determinethe correlation coefficient between these variables.

Solution: Calculation of Correlation Coefficient

Advertisement expenditure Rs. (X)	**Sales Rs. (Y)**	**XY**	**X^2**	**Y^2**
	60	360.0	36	3600
	55	275.0	25	3025
	50	250.0	25	2500
	40	160.0	16	1600
	35	105.0	9	1225
	30	60.0	4	900
	20	40.0	4	400

1	15	22.5	2.25	225
1	11	11.0	1	121
0	10	5.0	0.25	100
∑X = 3	∑Y = 326	∑XY = 1288.5	$\sum X^2$=122.50	$\sum Y^2$=13696

We know that,

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}}\sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}}$$

$$r = \frac{\frac{1288.5-(30)(326)}{10}}{\sqrt{122.5-\frac{(30)^2}{10}}\sqrt{13696-\frac{(326)^2}{10}}}$$

$$r = \frac{310.5}{315.7}$$

$$r = 0.9835$$

The calculated coefficient of correlation r = 0.9835 shows that there is a high degree of association between the sales and advertisement expenditure. For thisparticular problem, it indicates that an increase in advertisement expenditure is likely to yield higher sales. If the results of the calculation show a strong correlation for the data, either negative or positive, then the line of best fit to that data will be useful for forecasting.

Testing for the Significance of the Correlation Coefficient

Once the coefficient of correlation has been obtained from sample data one is normally interested in asking the questions: Is there an association between thetwo variables? Or with what confidence can we make a statement about the association between the two variables? Such questions are best answered statistically by using the following procedure.

Testing of the null hypothesis (testing hypothesis and t-test are discussed in detail in Units 15 and 16 of this course) that population correlation coefficientequals zero (variables in the population are uncorrelated) versus alternative hypothesis that it does not equal zero, is carried out by using t-statistic formula.

$t = r\sqrt{\frac{n-2}{1-r^2}}$ Where, r is the correlation coefficient from sample

Referring to the table of t-distribution for (n–2) degree of freedom, we can findthe critical value for t at any desired level of significance (5% level of significance is commonly used). If the calculated value of t (as obtained by the above formula) is less than or equal to the table value of t, we accept the null hypothesis (H_0), meaning that the correlation between the two variables is not significantly different from zero.

The following example will illustrate the use of this test.

Illustration 1

Suppose, a random sample of 12 pairs of observations from a normal populationgives a correlation coefficient of 0.55. Is it likely that the two variables in the population are uncorrelated?

Solution: Let us take the null hypothesis (H_0) that the variables in thepopulation are uncorrelated.

Applying t-test,

$$t = r\sqrt{\frac{n-2}{1-r^2}} = 0.55\sqrt{\frac{12-2}{1-0.55^2}}$$

$$= 0.55 \times 3.786$$

$$= 2.082$$

From the t-distribution (refer the table given at the end of this unit) with 10 degrees of freedom for a 5% level of significance, we see that the table valueof $t_{0.05/2,\ (10-2)} = 2.228$. The calculated value of t is less than the table value of t. Therefore, we can conclude that this r of 0.55 for n = 12 is not significantly different from zero. Hence our hypothesis (H_0) holds true, i.e., the sample variables in the population are uncorrelated.

Let us take another illustration to test the significance.

Illustration 2

A random sample of 100 pairs of observations from a normal population gives acorrelation coefficient of 0.55. Do you accept that the variables in the population are correlated?

Solution: Let us take the hypothesis that the variables in the population areuncorrelated. Apply the t-test:

$$t = r\sqrt{\frac{n-2}{1-r^2}} = 0.55\sqrt{\frac{100-2}{1-0.55^2}}$$

$$= 6.52$$

Referring to the table of the t-distribution for n–2 = 98 degrees of freedom, the critical value for t at a 5% level of significance $[t_{0.05/2,\ (10-2)}] = 1.99$ (approximately). Since the calculated value of t (6.52)

exceeds the table value of t (1.99), we can conclude that there is statistically significant associationbetween the variables. Hence, our hypothesis does not hold true.

SIMPLE LINEAR REGRESSION

When we identify the fact that the correlation exists between two variables, weshall develop an estimating equation, known as regression equation or estimatingline, i.e., a methodological formula, which helps us to estimate or predict the unknown value of one variable from known value of another variable. In the words of Ya-Lun-Chou, "regression analysis attempts to establish the nature of the relationship between variables, that is, to study the functional relationship between the variables and thereby provide a mechanism for prediction, or forecasting. Thus, the statistical method which is used for prediction is called regression analysis. And, when the relationship between the variables is linear, the technique is called **simple linear regression**.

Hence, the technique of regression goes one step further from correlation andis about relationships that have been true in the past as a guide to what may happen in the future. To do this, we need the regression equation and the correlation coefficient. The latter is used to determine that the variables are really moving together.

The objective of simple linear regression is to represent the relationship betweentwo variables with a model of the form shown below:

$$Y_i = \beta_0 + \beta_1 X_i + e_i$$

Y_i = value of the dependent variable,

β_0 = Y-intercept,

β_{1_1} = slope of the regression line,

X_i = value of the independent variable,

e_i = error term (i.e., the difference between the actual Y value and the valueof Y predicted by the model.

ESTIMATING THE LINEAR REGRESSION

If we consider the two variables (X variable and Y variable), we shall havetwo regression lines. They are:

i) Regression of Y on X
ii) Regression of X on Y.

The first regression line (Y on X) estimates value of Y for given value of X. The second regression line (X on Y) estimates the value of X for given valueof Y. These two regression lines will coincide, if correlation between the variable is either perfect positive or perfect negative.

The best regression line is the one thatminimizes the sum of squared vertical distances between the observed (X, Y) points and the regression line, i.e., $\sum(Y - \hat{Y})^2$ is the least value and the sum of the positive

and negative deviations is zero, i.e., $\sum(Y - \hat{Y}) = 0$. It is important to note that the distance between (X, Y) points and the regression line is calledthe 'error'.

Regression Equation of Y on X

$$\hat{Y} = a + bx$$

where,

$\hat{Y}$ is the computed values of Y (dependent variable) from the relationship for a given X, 'a' and 'b' are constants (fixed values), 'a' determines the level of the fitted line at Y-axis (Y-intercept), 'b' determines the slope of the regression line, X represents a given value of independent variable.

The alternative simplified expression for the above equation is:

$$\hat{Y} - \bar{Y} = byx\ (X - \bar{X})$$

$$byx = r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sum X^2 - \frac{(\sum X)^2}{N}}$$

Regression equation of X on Y

$$\hat{X} = a + by$$

Alternative simplified expression is :

$$\hat{X} - \bar{X} = bxy\ (Y - \bar{Y})$$

$$bxy = r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sum Y^2 - \frac{(\sum Y)^2}{N}}$$

It is worthwhile to note that the estimated simple regression line always passes through $\bar{X}$ and $\bar{Y}$. The following illustrationshows how the estimated regression equations are obtained, and hence how they are used to estimate the value of Y for given X value.

Illustration

From the following 12 months sample data of a company, estimate the regression lines and also estimate the value of sales when the company decidedto spend Rs. 2,50,000 on advertising during the next quarter. (Rs. in lakh)

Advertisement Expenditure	0.8	1.0	1.6	2.0	2.2	2.6	3.0	3.0	4.0	4.0	4.0	4.6
Sales	22	28	22	26	34	18	30	38	30	40	50	46

Solution:

Table 10.4: Calculations for Least Square Estimates of a Company. (Rs. in lakh)

Advertising (X)	Sales (Y)	X^2	Y^2	XY
0.8	22	0.64	484	17.6
1.0	28	1.00	784	28.0
1.6	22	2.56	484	35.2
2.0	26	4.00	676	52.0
2.2	34	4.84	1156	74.8
2.6	18	6.76	324	46.8
3.0	30	9.00	900	90.0
3.0	38	9.00	1,444	114.0
4.0	30	16.00	900	120.0
4.0	40	16.00	1600	160.0
4.0	50	16.00	2,500	200.0
4.6	46	21.16	2,116	211.6
$\sum X=32.8$	$\sum Y=384$	$\sum X^2=106.96$	$\sum Y^2=13368$	$\sum XY=1,150.0$

Now we establish the best regression line (estimated by the least square method).

We know the regression equation of Y on X is:

$$\hat{Y} - \bar{Y} = byx\ (X - \bar{X})$$

$$\bar{Y} = \frac{384}{12} = 32$$

$$\bar{X} = \frac{32.8}{12} = 2.733$$

$$\hat{Y} - \bar{Y} = byx\ (X - \bar{X})$$

$$byx = r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sum X^2 - \frac{(\sum X)^2}{N}}$$

$$= \frac{1.150 - \frac{(32.8)(384)}{12}}{106.96 - \frac{(32.8)^2}{12}} = 5.801$$

$$\hat{Y} - 32 = 5.801\ (X - 2.733)$$

$$\hat{Y} = 5.801X - 15.854 + 32$$

= 5.801X + 16.146

It is worthwhile to note that the relationship displayed by the scatter diagrammay not be the same if the estimating equation is extended beyond the data points (values) considered in computing the regression equation.

Using Regression for Prediction

Regression, a statistical technique, is used for predictive purposes in applicationsranging from predicting demand sales to predicting production and output levels. In the above illustration 6, we obtained the regression model of the company for predicting sales which is:

$\hat{Y} = 16.146 + 5.801X$

where $\hat{Y}$ = estimated sales for given value of X, and

X = level of advertising expenditure.

To find $\hat{Y}$, the estimate of expected sales,

We substitute t he specified advertising level into the regression model. For example, if we know that the company's marketing department has decided to spend Rs. 2,50,000/- (X = 2.5)on advertisement during the next quarter, the most likely estimate of sales ($\hat{Y}$)

is :$\hat{Y} = 16.1436 + 5.801(2.5) = 30.6455$

= Rs. 30,64,850

Thus, an advertising expenditure of Rs. 2.5 lakh is estimated to generate salesfor the company to the tune of Rs. 30,64,850.

Similarly, we can also establish the best regression line of X on Y as follows:Regression Equation of X on Y

$$\hat{X} - \bar{X} = bxy\,(Y - \bar{Y})$$

$$bxy = r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sum Y^2 - \frac{(\sum Y)^2}{N}}$$

$$= \frac{1.150 - \frac{(32.8)(384)}{12}}{147456 - \frac{(384)^2}{12}} = 0.093$$

$$\hat{X} - 2.733 = 0.093Y - 2.976$$

$$\hat{X} - 2.733 = 0.093(Y - 32)$$

$$\hat{X} = 0.093Y - 0.243$$

The following points about the regression should be noted:

1) The geometric mean of the two regression coefficients (byx and bxy) givescoefficient of correlation.

That is, $r = \pm\sqrt{(bxy)\ (byx)}$

Consider the values of regression coefficients from the previous illustration toknow the degree of correlation between advertising expenditure and sales.

$r = \pm \sqrt{0.093 \times 5.801} = 0.734$

2) Both the regression coefficients will always have the same sign (+ or –).

3) Coefficient of correlation will have the same sign as that of regression coefficients. If both are positive, then r is positive. In case both are negative, ris also negative. For example, bxy = –1.3 and byx = –0.65, then r is:

   $\pm \sqrt{-1.3x - 0.65}$ = -0.919 butnot +0.919

4) Regression coefficients are independent of change of origin, but not of scale.

Standard Error of Estimate

Once the line of best fit is drawn, the next process in the study of regression analysis is how to measure the reliability of the estimated regression equation. Statisticians have developed a technique to measure the reliability of the estimated regression equation called "Standard Error of Estimate (S_e)." This S_e is similar to the standard deviation which we discussed in Unit-9 of this course.We will recall that the standard deviation is used to measure the variability of adistribution about its mean. Similarly, **the standard error of estimate measures the variability, or spread, of the observed values around the regression line.** We would say that both are measures of variability. The larger the value of S_e, the greater the spread of data points around the regression line. If S_e is zero, then all data points would lie exactly on the regression line. In that case the estimated equation is said to be a perfect estimator. The formula to measure S_e is expressed as:

$$S_e = \sqrt{\frac{\sum(Y - \hat{Y})^2}{n}}$$

Where, S_e is standard error of estimate, Y is values of the dependent variable, $\hat{Y}$ is estimated values from the estimating equation that corresponds to each Y value, and n is the number of observations (sample size).

Let us take up an illustration to calculate S_e in a given situation.

Illustration

Consider the following data relating to the relationships between expenditure onresearch and development, and annual profits of a firm during 1998–2004.

Years:	1998	1999	2000	2001	2002	2003	2004
R&D (Rs. lakh):	2.5	3.0	4.2	3.0	5.0	7.8	6.5

Profit (Rs. lakh):	23	26	32	30	38	46	44

The estimated regression equation in this situation is found to be

$\hat{Y} = 14.44 + 4.31x$. Calculate the standard error of estimate.

Note: Before proceeding to compute S_e you may calculate the regression equation of Y on X on your own to ensure whether the given equation for theabove data is correct or not.

Solution: To calculate S_e for this problem, we must first obtain the value of

$\sum (Y - \hat{Y})^2$. We have done this in Table 10.5.

Table 10.5: Calculation of $\sum(Y- \hat{Y})^2$ **(Rs. in lakh)**

Years	**Expendi-ture on R&DX**	**Profit** **Y**	$\hat{y}$ **Estimating values (14.44 + 4.31X)**	**Individualerro** $(y - \hat{y})$	$(y - \hat{y})^2$
1998	2.5	23	14.44 + 4.31(2.5) = 25.21	–2.21	4.88
1999	3.0	26	14.44 + 4.31(3) = 27.37	–1.37	1.88
2000	4.2	32	14.44 + 4.31(4.2) = 32.54	–0.54	0.29
2001	3.0	30	14.44 + 4.31(3) = 27.37	2.63	6.92
2002	5.0	38	14.44 + 4.31(5) = 35.99	2.01	4.04
2003	7.8	46	14.44 + 4.31(7.8) = 48.06	–2.06	4.24
2004	6.5	44	14.44 + 4.31(6.5) = 42.46	1.54	2.37

$\sum (Y - \hat{Y})^2 = 24.62$

We can, now, find the standard error of estimate as follows.

$$S_e = \sqrt{\frac{\sum(Y-\hat{Y})^2}{n}}$$

$$= \sqrt{\frac{24.62}{7}}$$

$$= 1.875$$

Standard error of estimate of annual profit is Rs. 1.875 lakh.

Factor Analysis

Factor analysis is a general label applied to a set of statistical procedures designed to identify the basis dimension or factors that underline the relationship among a large number of variable.

Harman (1960) defines the procedure of factor analysis follows: "The principal concern of factor analysis is the resolution of a set of variables linear by in terms of a smaller number of categories or 'factors'. This resolution can be accomplished by the analysis of the correlation among the variables. A satisfactory solution will yield factors, which convey all the essential information of the original set of variables. Thus, the chief aim is to attain scientific parsimony or economy of description".

Guilford (1956) outlines the different steps in factor analytic study in the following term:

a) Select an appropriate domain for investigation.
b) Develop a hypothesis concerning the factor.
c) Select or construct suitable tests.
d) Select a suitable population.
e) Obtain a sample of adequate size.
f) Extract factors with commonalities in the diagonal cells of the correlation matrix.
g) Rotate the reference axes and
h) Interpret the rotated factors.

The present investigation made use of principal-axes method, as it is one of the satisfactory procedures of factor analysis. Fruchter (1954) explains the superiority of this method in the following terms.

The principal-axes method of factoring the correlation matrix is of interest for several reasons. Each factor extracts the maximum amount of variance, (i.e., the sum of squares of factors loadings is maximized on each factor) and gives the smallest possible residuals. The correlation matrix is condensed into the smallest number of orthogonal factors by this method. The method also has an advantage of giving mathematically unique (least square) solution for a given table of correlations. Harman (1960) points out that this method needs larger number of computations. But this difficulty is overcome with the help of high-speed computers.

Test of Significance of Extracted Factors

The test of significance is applied to the obtained factors and only those, which are significant, are retained for final interpretation.

Interpretations of factors: Principles and Criteria

a) Locate the group of variables in which the factor has the highest loadings.
b) Locate the group of variables in which the factor has the lowest loadings.
c) Examine the possibility of different factors becoming independent and
d) Treat factor loading whose absolute values are greater than 0.30 as significant and neglect others as not significant.

The degree of presence of each variable is a factor determined as follows:

a) Factor loading above 0.900 - extremely high presence of the variable
b) Factor loading above 0.700 to 0.900 – high presence of variable.
c) Factor loading above 0.550 to 0.700 – considerable presences.
d) Factor loading above 0.450 to 0.550 - variable somewhat presence.
e) Factor loading above 0.300 to 0.450 – variable presence but low, and
f) Factor loading below 0.300 – variable not presence.

Non - parametric test

1) Characteristics common to most non-parametric techniques:

- Fewer assumptions regarding the population distribution
- Sample sizes are often less stringent
- Measurement level may be nominal or ordinal
- Independence of randomly selected observations, except when paired
- Primary focus is on the rank ordering or frequencies of data
- Hypotheses are posed regarding ranks, medians, or frequencies of data

2) Conditions when it is appropriate to use a non-parametric Test:

- Nominal or ordinal level of measurement
- Small sample sizes
- Non-normal distribution of dependent variable
- Unequal variances across groups
- Data with not able outliers

3) disadvantages of Non-parametric Tests:

- Methods quick and easy to apply
- Theory fairly simple

- Assumptions for tests easily satisfied
- Accommodate un usual or irregular sample distributions
- Basic data need not be actual measurements
- Use with small sample sizes
- Inherently robust due to lack of stringent assumptions
- Process of collecting data may conserve time and funds
- Often offer a selection of inter change able methods
- Can be used with samples made up of observations from several different populations

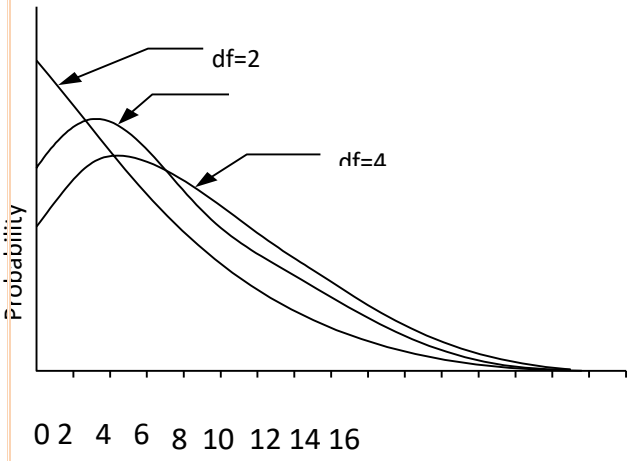
CHI-SQUARE DISTRIBUTION

Chi-square tests enable us to test whether more than two population proportions are equal. Also, if we classify a consumer population into several categories (say high/medium/low income groups and strongly prefer/moderately prefer / indifferent/ do not prefer a product) with respect to two attributes (say consumer income and consumer product preference), we can then use chi-square test to test whether two attributes are independent of each other.

CHI-SQUARE DISTRIBUTION

The chi-square distribution is a probability distribution. Under some proper conditions the chi-square distribution can be used as a sampling distribution of chi-square. The chi-square distribution is known by its only parameter–number of degrees of freedom. The meaning of degrees of freedom is the same as the one you have used in student -distribution. Figure shows the three different chi-square distributions for three different degrees of freedom.

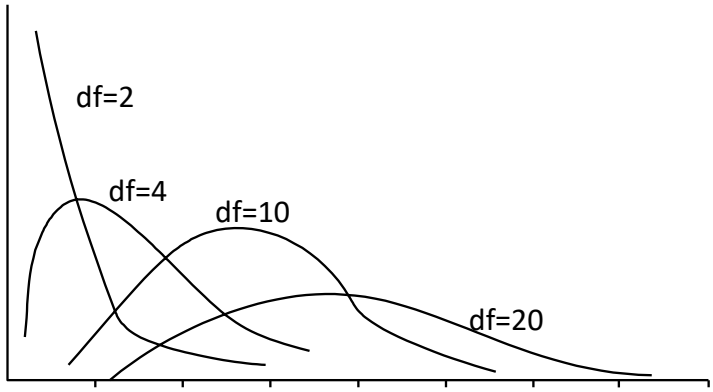
Chi-SquareTest



Chi-Square Sampling Distributions for df=2,3 and 4

It is to be noted that as the degrees of freedom are very small, the chi-square distribution is heavily skewed to the right. As the number of degrees of freedom increases, the curve

rapidly approaches symmetric distribution. You may be aware that when the distribution is symmetric, it can be approximated by normal distribution. Therefore, when the degrees of free do increase sufficiently, the chi-square distribution approximates the normal distribution. This is illustrated *in Figure*.



Chi-Square Sampling Distributions for df = 2,4,10, and 20

Like student t-distribution there is a separate chi-square distribution for each number of degrees of freedom. Table-1 gives the most commonly used tail areas that are used in tests of hypothesis using chi-square distribution.

Region	Consumer preference		Total
	Brand A	Brand B	
South North	64	16	80
East West	24	6	30
Central	23	7	30
North-east	56	44	100
	12	18	30
	12	18	30
Total	191	109	300

llustration2

A sales man has 3 products to sell and there is a 40% chance of selling each product when he meets a customer. The following is the frequency distribution of sales.

No. of products sold per sale:	0	1	2	3
Frequency of the number of sales:	10	40	60	20

At the 0.05 level of significance, do these sales of products follow a binomial distribution?

Solution: In this illustration, the sales process is approximated by a binomial distribution with P=0.40 (with a 40% chance of selling each product).

Ho: The sales of three products has a binomial distribution with P = 0.40.

H_1: The sales of three products do not have a binomial distribution with P = 0.40.

Before we proceed further we must calculate the expected frequencies inorder to determine whether the discrepancies between the observed frequencies and the expected frequencies (based on binomial distribution) should be a scribed to chance. We began determining the binomial probability in each situation

of sales (0,1,2,3 products sold per sale). For three products, we would find the probabilities of success by consulting the binomial probabilities Appendix Table-

1. By looking at the column labeled as n=3 and p=0.40 we obtained the following figures of binomial probabilities of the sales.

No. of products sold per sale(r)	Binomial probabilities of the sales
0	0.216
1	0.432
2	0.288
3	0.064
	1.000

We now calculate the expected frequency of sales for each situation. There are 130 customers visited by the sales man. We multiply each probability by 130 (no. of customers visited) to arrive at there spective expected frequency. For example, 0.216×130 = 28.08.

The following table shows the observed frequencies and the expected frequencies.

No. of products sold per sale	Observed frequency	Binomial probability	Number of customers visited	Expected frequency
(1) (4)	(2)	(3)	(4)	(5)=(3)×
0	10	0.216	130	28.08
1	40	0.432	130	56.16
2	60	0.288	130	37.44
3	20	0.064	130	8.32
Total	130			

Now we use the chi-square test to examine the significance of differences between observed frequencies and expected frequencies. The formula for calculating chi-square

The following table gives the calculation of chi-square.

Observed frequencies(O_i)	Expected frequencies(E_i)	(O_i–E_i)	$(O–E)^2$ i i	$(O –E)^2/E$ i i i
10	28.08	–18.08	326.89	11.64
40	56.16	–16.16	261.15	4.65
60	37.44	22.56	508.95	13.59
20	8.32	11.68	136.42	16.40
130	130			χ^2= 46.28

In order to draw in frequencies about this calculated value of χ^2 we are required to compare this with table value of χ^2. For this we need: (i)degrees of freedom (n-1), and (ii) level of significance. In the problem we are given that the level of significance is 0.05. The number of expected situations is 4. That is (0,1,2,3 products sold per sale) n=4. Therefore, the degrees of freedom will be 3 (i.e.,n-1=4–1=3). The table value from Appendix Table-4 is 7.815 at 3 degrees of free domand 0.05 level of significance. Since the calculated value (χ^2=46.28) is greater than the table value (7.815), we reject the null hypothesis and accept the alternative hypothesis. We conclude that the observed frequencies do not follow the binomial distribution.

Let us take another illustration which relates other normal distribution

CONDITIONS FOR APPLYING CHI-SQUARE TEST

To validate the chi-square test, the data set available, needs to fulfill certain conditions. Sometimes these conditions are also called precautions about using the chi-square test. Therefore, whenever you use the chi-square test the following conditions must be satisfied:

a) **Random Sample**: In chi-square test the data set used is assumed to be a random sample that represents the population. As with all significance tests, if you have a random sample data that represents population data, then any differences in the table values and the calculated values are real and therefore significant. On the other hand, if you have a non-random sample data, significance cannot be established, though the tests are nonetheless sometimes utilized as crude "rules of thumb" any way. For example, we reject the null hypothesis, if the difference between observed and expected frequencies is too large. But if the chi-square value is zero, we should be careful in interpreting that absolutely no difference exists between observed and expected frequencies. Then we should verify the quality of data collected whether the sample data represents the population or not.

b) **Large Sample Size**: To use the chi-square test you must have a large sample size that is enough to guarantee the test, to test the similarity between the theoretical distribution and the chi-square statistic. Applying chi-square test to

small samples exposes their searcher to an unacceptable rate of type-II errors. However, there is no accepted cut off sample size. Many researchers set the minimum sample size at 50. Remember that chi-square test statistic must be calculated on actual count data (nominal, ordinal or interval data) and not substituting percentages which would have the effect of projecting the sample size as100.

c) **Adequate Cell Sizes**: You have seen above that small sample size leads to type-II error. That is, when the expected cell frequencies are too small, the value of chi-square will be overestimated. This in turn will result in too many rejections of the null hypothesis. To avoid making in correct inferences from chi-square tests we follow a general rule that the expected frequency in any cell should be a minimumof5.

d) **Independence**: The sample observations must be independent.

e) **Final values**: Observations must be grouped in categories.

Since the expected frequencies (cell values) in the third row are less than 5 we pool the third row with the second row of both observed frequencies and expected frequencies. The revised observed frequency and expected frequency tables are given below.

Degree of acceptance			Region		
	South	North	East	West	Total
Strong	30	25	20	30	105
Moderate and poor	20	25	20	20	85
Total	50	50	40	50	190

Degree of acceptance			Region		
	South	North	East	West	Total
Strong	27.63	27.63	22.11	27.63	105
Moderate and poor	22.37	22.37	17.89	22.37	85

Total	50

MANN WHITNEY 'U' TEST

The Mann-Whitney (Wilcoxon) rank-sum test is a non-parametric analog of the two-sample *t* test for independent samples. The *Mann-Whitney U test* is a non-parametric test that can be used to analyse data from a two-group independent groups design when measurement is at least ordinal. It analyses the *degree of separation* (or the amount of overlap) between the Experimental (E) and Control(C) groups.

The *null hypothesis* assumes that the two sets of scores (E and C) are samples from the same population; and

therefore, because sampling was random, the two sets of scores *do not differ systematically* from each other.

The *alternative hypothesis*, on the other hand, states that the two sets of scores *do* differ systematically. If the alternative is directional, or one-tailed, it further specifies the direction of the difference (i.e.,Group E scores are systematically higher or lower than Group C scores).

The statistic that is calculated is either UorU'.U1=the number of Es less than Cs
U2=the number of Cs less than Es

U=the smaller of the two values calculated above U'=the larger of the two values calculated above

When you perform these tests, your data should consist of a random sample of observations from two different populations. Your goalis to compare either the location parameters (medians) or the scale parameters of the two populations. For example, suppose your data consist of the number of days in the hospital for two groups of patients: those who received a standard surgical procedure and those who received a new, experimental surgical procedure. These patient's area random sample from the population of patients who have received the two types of surgery. Your goalis to decide whether the median hospital stays differ for the two populations.

RELEVANT BACK GROUND INFORMATION ON 'U' TEST

The Mann-Whitney *U* test is employed with ordinal (rank-order) data in a hypothesis testing situation involving a design with two independent samples. If the result of the Mann-Whitney *U* test is significant, it indicates there is a significant difference between the two sample medians, and as a result of the latter the researcher can conclude there is a high likelihood that the samples represent populations with different median values.

Two versions of the test to be described under the label of the Mann-Whitney *U* test were independently developed by Mann and Whitney (1947) and Wilcoxon (1949).

The version to be described here is commonly identified as the Mann-Whitney *U* test, while the version developed by Wilcoxon (1949) is usually referred to as the Wilcoxon-Mann-Whitney test.' Although they employ different equations and different tables, the two versions of the test yield comparable results.

In employing the Mann-Whitney *U* test, one of the following is true with regard to the rank order data that are evaluated:

a) The data are in a rank order format, since it is the only format in which scores are available ; or

b) The data have been transformed in to a rank order format from an interval ratio format, since there searcher has reason

to believe that the normality assumption (as well as, perhaps, the homogeneity of variance assumption) of the t test for two independent samples (which is the parametric analog of the Mann-Whitney U test) is saliently violated.

It should be noted that when a researcher elects to transform a set of interval / ratio data in to ranks, information is sacrificed. This latter fact accounts for the reluctance among some researchers to employ non-parametric tests such as the Mann-Whitney *U* test, even if there is reason to believe that one or more of the assumptions of the t test for two independent samples have been violated.

The Mann-Whitney U test is based on the following assumptions:

a) Each sample has been randomly selected from the population it represents;

b) The two samples are independent of one another;

c) The original variable observed (which is subsequently ranked) is a continuous random variable. In truth, this assumption, which is common to many non-parametric tests, is often not adhered to,in that such tests are often employed with a dependent variable which represents a discrete random variable; and

d) The underlying distributions from which the samples are derived are identical in shape. The shapes of the underlying population distributions, however, do not have to be normal.

Maxwell and Delaney (1990) pointed out the assumption of identically shaped distributions implies equal dispersion of data with in each distribution. Because of this, they note that like the *t* test for two independent samples, the Mann-Whitney *U* test also assumes homogeneity of variance with respect to the underlying population distributions.

Because the latter assumption is not generally acknowledged for the Mann-Whitney *U* test, it is not uncommon for sources to state that violation of the homogeneity of variance assumption justifies use of the Mann-Whitney *U* test in lieu of the *t* test for two independent samples.

It should be pointed out, however, that there is some empirical evidence which suggests that the sampling distribution for the Mann-Whitney *U* test is not as affected by violation of the homogeneity of variance assumption as is the sampling distribution for *t* test for two independent samples. One reason cited by various sources for employing the Mann-Whitney *U* test is that by virtue of ranking interval/ratio data, a researcher will be able to reduce or eliminate the impact of outliers.

STEP BY STEP PROCEDUR

E FOR 'U' TEST FOR SMALL SAMPLE

Step-by-step procedure

Mann Whitney U Test for Small Sample case (not more than 20 items in each set), use U if the data is

a) In the form of ranks or

b) Not normally distributed

c) There is an obvious difference in the variance of the two groups.

STEP1: Rank the data (taking both groups together) giving rank1 to the lowest score, and the highest rank to the highest score.

STEP2: Find the sum of the ranks for the smaller sample

STEP3: Find the sum of the ranks for the larger sample

STEP4: Find U applying the formula given below:

$U = N_1N_2 + [N_1(N_1+1)/2] - \square R_1$ and

$U\square = N_1N_2 + [N_2(N_2+1)/2] - \square R_2$

STEP5: Look up the smaller of U and U' in Table H. There is a significant difference if the observed value is equal to or more than the table value.

STEP6: Translate the results of the test back in the terms of experiment.

Worke

Team A		Team B	
Score	Rank (R_1)	Score	Rank (R_2)
72	13	97	25
67	10	76	16
87	21	83	19
46	2	69	12
58	6	56	5
63	8	68	11
84	20	92	24
53	3	88	22
62	7	74	15
77	17	73	14
82	18	65	9
89	23	54	4
		43	1
	$\sum R1 = 148$		$\sum R2 = 177$

Step1: Rank the ratings from lowest to highest regardless of assessment team.

Step2: Sum the ranks in either group

$\square(R_1)=148$

$\square(R_2)=177$

Step3: Calculate U

$U = N_1N_2 + [N_1(N_1+1)/2] - \square R_1$

$U=(12)(13)+[12(12+1)/2]-148$

$U=156+78-148=86$ and Calculate U'

$U\square = N_1N_2 + [N_2(N_2+1)/2] - \square R_2$

13)+[13(13+1)/2]-177

U□=156+91–175=70

Step4: Determine the significance of U

Decide whether you are making a one-or a two-tailed decision

Compare the smaller value of U to the appropriate critical table value for N_1 and N_2 .If the observed U is smaller than the table value, the result is significant.

Step5: The critical value of U for N_1= 12 and N_2=13, two-tailed □ =0.05, is 41.

Since the smaller obtained value of U (U□=70) is larger than the table value, the null hypothesis is accepted. And we conclude that there is no significant difference in the ratings given by the two assessment teams.

STEP BY STEP PROCEDURE FOR 'U' TEST FOR LARGE SAMPLE

When both sample sizes are greater than about 20, the sampling distribution of U is for practical purposes, normal. Therefore, under these conditions, one can perform a z-test as follows:

The procedure to obtain U is similar as in small sample case (Step1to3). Then the formula for Z is applied as:

$$Z = [U-(N_1N_2)/2]/\sqrt{(N_1+N_2+1)/12\ N_1N_2}$$

If we are dealing with a two-tailed test, then the observed z is significant at the 5 percent level if it exceeds 1.96. For one tailed test, 5 percent significance is attained if z exceeds1.64(Check these in table D in Statistics book original).

The ranking procedure can become quite laborious in large samples. Partly for this reason and partly because violation of the assumptions behind parametric statistics become less important for large sample, the Mann Whitney U test tends to be restricted to use with relatively small samples.

COCHARNS Q TEST

This producer computes the non-parametric Cochrans Q test for related categories where the response is binary. Cochrans Q is used for testing k= 2 or more matched sets, where a binary response (e.g. 0 or 1) is recorded from each category within each subject. Cochrans Q test the null hypothesis that the alternative that the proportion is different in at least one of the groups.

Cochrans Q test is an extension of the McNemar test to a situation where there are more than two matched samples. When Cochrans Q test is computed with only k= 2 groups, the results are equivalent to those obtained from the McNemar test (without continuity correction0. Cocharans Q is also considered to be a special case

of the non-parametric Friedman test, which is similar to repeated measures ANOVA and is used to detect differences in multiple matched sets with numeric responses. when the responses are binary, the Friedman test becomes Cochrans Q test.

This procedure also computes two-sided, pair wise multiple comparision tests that allow you to determine which of the individual groups are different if the null hypothesis in Cochrans Q test is rejected. The individual alpha level is adjusted using the Bonferroni method to control the overall experiment-wise error rate.

This procedure is based on the results and formulas given in chapter 26 of Sheskin (2011). We refer you there for additional information about Cocharans Q test.

Cochrans Q Teast Statistic

For binary responses, Yi, j in k matched groups from N subjects, the Cochrans Q test statistic is computed as

Cochran's Q Test Statistic

For Binary response Y_{ij} in k matched groups from N subjects, the Cochran's Q test statistic is computed as

$$Q = \frac{(k-1)[kC-T]^2}{kT-R}$$

where

$$C = \sum_{j=1}^{k}\left(\sum_{i=1}^{N} y_{ij}\right)^2$$

$$T = \sum_{i=1}^{N}\left(\sum_{u=1}^{k} y_{ij}\right)^2$$

$$R = \sum_{i=1}^{N}\left(\sum_{u=1}^{k} y_{ij}\right)^2$$

For "large" samples, the test statistic Q, is distributed as chi-square k-1 degrees of freedom. As I test, only subjects have same response in all categories contribute to the Q statistic.

Sign Test

Among the non-parametric tests, the Sign test is known for its simplicity. It is used for comparing two correlated samples namely, two parallel sets of measurements which are paired off in some way. For comparison, the difference between each pair

of observations is obtained, and then the significance of such differences is tested by the application of the Sign test. The word "Sign" is attached to this test since it uses plus and minus signs instead of quantitative measures as its data. This test makes useful contribution in situations where:

1. We need not consider any assumption regarding the form of distributions such as normality, homosedasticity and the like except when the variable under consideration has a continuous distribution.
2. We need not assume that all the subjects are drawn from the same population.
3. We are assigned the task of comparing two correlated samples, with the aim of testing the null hypothesis which states that the median difference between the pairs is zero.
4. In the correlated samples to be compared we must have two parallel sets of measurement that are paired off In some way(matched with respect to the relevant extraneous variables).
5. The measurement in two parallel sets is neither on an interval nor on a ratio scale; but is available either in the form of ranking or simply showing the direction of differences in the form of positive or negative signs.

Illustration of the use of Sign test (small samples N≤ 25)

A researcher selected 20 students for a study. he divided them into two groups in terms of their intelligence and socio-economic status. These two groups were given training in table manners and cleanliness in two different settings and were then rated for their behavioural performance by a panel of judges. Although the pooled rating scores were not so objective, they were quite enough to provide direction of differences between each pair. For this data, he wanted to know which one of the training set-ups was better. The pooled rating scores of the 10 matched pairs are given in the table.

Pooled rating scores in two groups

Matched pair	Group 1	Group 2	Sign of difference
(a)	(b)	(c)	(d)
1	25	24	+
2	15	16	-
3	12	12	0
4	22	24	-
5	20	18	+
6	19	20	-
7	8	10	-
8	18	15	+
9	24	21	+
10	17	17	0

Method

Step 1: Determine the signs of differences and enter these as + and – signs in column (d). for zero differences, enter 0.

Step 2: Now, count the number of positive, negative and zero differences. Since the zero differences have neither plus nor minus signs, they can be eliminated from N (total number of pairs). As a result, in the present example we have 9 pairs (N=9), out of which 6 are positive and 3 are negative. Use this

formula for determining N (N=No. of matched pairs showing + and – signs).

Step 3: establish a null hypothesis (H_0), i.e. the hypothesis of no difference

H_o = Median of differences between the pairs is zero

In a one-tailed test we can have

H_1 = Median of difference is positive or negative

In a two-tailed test we have

H_2 = Median of difference is significant (positive or negative)

In this case, we must know which one of the training set-ups is better since there are more positive sings. Thus we can establish H_1, that the first training set-up, is better than the second.

Step 4: Determine whether the sample of study is small or large. If N is smaller than 25, it should be taken as a small sample, but if it is larger than 25, it should be regarded as a large sample.

Step 5: The Sign test is based on the idea that under the null hypothesis, we expect the differences between the paired observations to be half-positive and half-negative. Hence the probability associated with the occurrence of a particular number + (p) and – (q) signs can be determined with reference to binomial distribution (the distribution with equal chances), i.e. p = q = 1/2, and N= p + q. for this purpose we have constructed binomial probabilities distribution table of the appendix which gives the probabilities associated with the occurrence under the H_o of values as small as x for N=25.

Let us illustrate the use of probability table

x= No. of fewer signs (whether +ve or –ve). In the present example.

x = No. of fewer signs = No. of negative signs = 3

From the probability table, N= 9, x = 3

The one-tailed probabilities of occurrence under H_o are P = 0.254.

Step 6: Examine the value of p. if it is equal to or lesser than (the given levels of significance, 0.01 at 1% level or 0.05 at 5% level), then reject H_o. In this example, p is 0.254. This value of p is greater than 0.05 at 5% level of significance. Hence, it does not lie in the area of rejection. It leads us to accept H_o in favour of H_1, and we can safely conclude that the first training method was no better than the second.

Note. In the case of a two-tailed test, the values of p read from the table for the given N and x doubled.

Sign test with large samples (N > 25)

If N (the total of the plus and minus signs) is larger than 25, the normal approximation to the binomial distribution or X^2 may be used, preferably with Yates correlation.

How to use normal approximation for binomial distribution

Step 1: Compute the value of z by using the formula

$$Z = \frac{x - \frac{N}{2}}{\frac{1}{2}\sqrt{N}}$$ (z is approximately normally distributed with zero mean and unit variance)

This approximation becomes excellent when correction for continuity (Yates correction) is employed and the formula is modified as

$$Z = \frac{(x \pm 0.5) - \frac{N}{2}}{\frac{1}{2}\sqrt{N}}$$

Step 2. After computing the value of z, table K in the appendix can be referred to. This table provides one-tailed probabilities (value of p) under H_o of various values of z. If this value of $p \leq 0.05$ (at 5% level of significance) or 0.01 (at 1% level of significance), H_o may be rejected at that level of significance. For a two tailed test, the value of p read from the table is doubled for the required analysis. Let us illustrate this with an example.

Example 16.2: Instead of 10 pairs taken for study, as in example 16.1, the researcher now has taken 50 pairs and analysed the obtained data in terms of signs as follows:

Number of positive signs = 37
Number of negative signs = 12
Number of zero signs = 1

Can you conclude from this data that the first training method was better than the second or vice versa.

Solution:

The null hypothesis in this case is that there exists no difference between the medians of the two treatments. Here, the value of N (the total number of positive and negative signs) is

N = 37 + 12 = 49

which is large and hence we have to consider the Sign tests meant for large samples.

Step 1. calculation of the value of z as

$$Z = \frac{(x \pm 0.5) - N/2}{\frac{1}{2}\sqrt{N}}$$

$$= \frac{(37 - 0.5) - 49/2}{\frac{1}{2}\sqrt{49}}$$

$$= \frac{2(36.5 - 24.5)}{7}$$

$$= \frac{24}{7}$$

$$= 3.43$$

Note. Here we have taken x = 37 (Number of positive signs). If we had taken x = 12 (Number of fewer signs), the calculation would have been

$$z = \frac{(12 + 0.5) - 49/2}{\frac{1}{2}\sqrt{49}}$$

$$= \frac{2(12.5 - 24.5)}{7}$$

$$= \frac{-12 \times 2}{7}$$

$$= \frac{-24}{7}$$

$$= -3.43$$

In both the cases, the numerical

value of z will be 3.43.

Step 2: After consulting table K of the appendix, we can read the one-tailed value of p associated with our computed z value of 3.43 as 0.0003

Conclusion

This value of p = 0.0003 is much smaller than the value of Alpha at 5% level, that is 0.05 or at 1% level or 0.01. Thus, we can reject H_o in favour of H_1 can say that the first training method was better than the second.

Evaluation of Sign Test

The sign test proves to be a quite simple and a practicable test in situations where it is difficult to use parametric tests like 't' test for testing the difference between two related samples. It is a distribution free test, does not require too many assumptions and can be used with small as well as large samples. The limitations of Sign test include the following.

1. It makes merely the use of signs the positive or the negative and, in this way, is unable to make use of all the available information regarding the quantitative values of the data. It takes into account only the direction and not the magnitude.
2. It is considered a less powerful test in comparison to t-test for the same data and therefore its use is recommended in cases where it is not safe for practicable to use ‘t’ or other parametric tests.

Non-parametric procedures are criticized for the following reasons:

Unable to estimate the population: Because non-parametric tests do not make strong assumptions about the population, a researcher could not make an inference that the sample statistic is an estimate of the population parameter.

Losing precision: Edgington (1995) asserted that when more precise measurements are available, it is unwise to degrade the precision by transforming the measurements into ranked data.

Low power: Generally speaking, the statistical power of non-parametric tests is lower than that of their parametric counterpart expect on a few occasions (Hodges & Lehmann, 1956; Tanizaki, 1997; Freidlin & Gastwirth, 2000).

False sense of security: It is generally believed that non-parametric tests are immune to parametric assumption violations and the presence of outliers. However, Zimmerman (2000) found that the significance levels of the WMW test and the KW test are substantially biased by unequal variances even when sample sizes in both groups are equal. In some cases the Type error rate can increase up to40-50%, and sometime 300%. The presence of outliers is also detrimental to non-parametric tests. Zimmerman (1994) outliers modify Type II error rate and power of both parametric and non-parametric tests are not as robust as

what many researchers thought.

Lack of software: Currently very few statistical software applications can produce confidence intervals for nonparametric tests. MINITAB and Stata are a few exceptions.

Testing distributions only: Further, non-parametric tests are criticized for being incapable of answering the focused question. For example, the WMW procedure tests whether the two distributions are different in some way but does not show how they differ in mean, variance, or shape. Based on this limitation, Johnson (1995) preferred robust procedures and data transformation to non-parametric tests (Robust procedures and data transformation will be introduced in the next section)

UNIT 3 REPORTING RESEARCH

Structure

3.0 INTRODUCTION

All research activities go waste unless the findings are recorded and reported for reference by persons other than the researcher(s). Therefore, every research activity is concluded by presenting the results including major and minor recommendations. The reporting of a research study depends on the purpose with which it was undertaken. One might have conducted a study as a personal research, as an institutional project, as a project funded by an outside agency, or towards fulfilling the requirement for the award of a degree. While a personal research may be published in any journal (without being recorded as a research report in a booklet form), projects and researches meant for the award of degrees are usually reported in book form, irrespective of whether they are published or not.

Research studies, when reported, follow certain standard patterns, styles and formats for maintaining parity in reporting and for easy grasp by others who are concerned with those studies. The present Unit is devoted to this aspect of educational research: How to write a research report? It starts with the purposes of writing a research report, followed by the components of the report itself (the beginning, the main body, and the end).

3.1 OBJECTIVES

After the completion of this Unit you should be able to

- State the reasons for writing a research report,
- List the three main components of a research report,
- Describe each component of a research report, and
- Write the final report of any research study, viz., its beginning, the main body, and the end of the report.

3.2 WHY AND HOW TO WRITE A RESEARCH REPORT

Once you complete your research project, you are expected to write the report. A research report is a precise presentation of the work done by a researcher while investigating a particular problem. Whether the study is conducted by an individual researcher or by an institution, the findings of the study should be reported for several reasons. The reasons are:

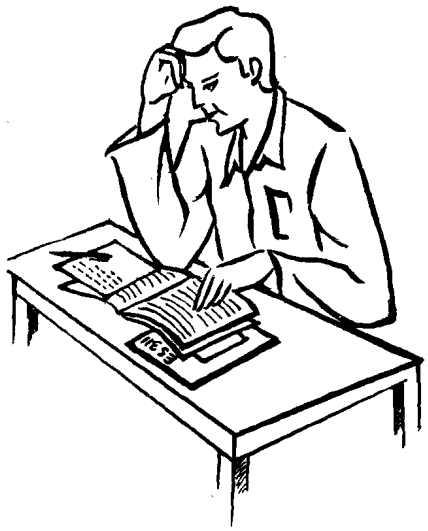


Fig.1: Reading a Research Report

- People learn more about the area of study.
- The discipline gets enriched with new theories.
- Researchers and practitioners in the field can apply, test and retest the findings already arrived at.
- Other researchers can refer to the findings and utilise the findings for further work.
- Findings can be utilized and implemented by the policy makers or those who had sponsored the project.

It is important to understand as to how to write a report. Your final report should be in accordance with the writing style used at your university. Whatever style you adopt, the content of the research report never varies. The final report of a research exercise takes a variety of forms.

- A research report funded by an educational institution may be in the form of a written document.
- A research report may also take the form of an article in a professional journal.

- The research reports of students of M.Sc., M.Ed., M.Phil. or Doctoral programmes take the form of a thesis or dissertation.

In the following sections we shall discuss the main components of a research report. The entire research report is mainly divided into three major divisions: — the beginning, the main body and the end (please see box).

Beginning	Main Body	End
➢ Cover Page ➢ Second Cover ➢ Preface ➢ Contents ➢ List of Table ➢ List of Figures	➢ Introduction ➢ Review of related literature ➢ Design of the study ➢ Analysis and interpretation of data ➢ Main findings and conclusions ➢ Summary	➢ Bibliography and reference ➢ Appendices

3.3 THE BEGINNING

The beginning of a report is crucial to the entire work. The beginning or the preliminary section of the research report contains the following items, more or less in the order given below:

- Cover or Title Page
- Preface including Acknowledgements
- Table of Contents
- List of Tables
- List of Figures and Illustrations
- Glossary

Let us describe in brief each of the above six items of the preliminary section of a report.

i) Cover or Title Page

The cover page (and the second cover page) is the beginning of the report. Though different colleges, universities and sponsoring institutions prescribe their own format for the title page of their project report or thesis, generally, it indicates the following in the downward vertical order:

- title of the topic,
- relationship of the report to a degree, course, or organisational requirement,

- name of the researcher/author,
- name of the supervisor/guide (if required),
- name of the institution where the report is to be submitted, and
- the date of submission.

The title page should carry a concise and adequately descriptive title of the research study. Preferably, it should not contain more than 12 to 15 words. The title should briefly convey what the study is about. Researchers tend to make errors in giving the title by using too many redundant and unimportant words.

Here, we have drawn a list of a few titles of research reports and doctoral theses:

a) A Critical Analysis of Textual Material for Principles of Accounting and its Translation for Distance Education
b) Developing Self-Instructional Material
c) Planning, Design and Development of one Self-Instructional Unit in Print
d) A Study of the Role of Distance Education in Zimbabwe in meeting the Manpower Training needs of the Education System with particular reference to the Bachelor of Education, Educational Administration, Planning and Policy Studies Programme intake II, in ManicaLand Province
e) The Zimbabwe Government Correspondence Primary School: A Case Study

In title (b), it is not clear at which level the researcher is developing self-instructional material. Title (d) has 40 words, whereas we have stated earlier that the title should be brief and concise. On the other hand, the title of the project (e) is comprehensive and precise.

The title should be written either in bold letters or upper-lower case and be placed in the central portion of the top of the cover page. Here, we have reproduced the cover page of a research report in Box. 1.

THE ZIMBABWE GOVERNMENT CORRESPONDENCE PRIMARY SCHOOL: A CASE STUDY

A project submitted in part fulfillment for the Masters of Arts in Distance Education Degree

By
S MANYUCHI

Supervisor
L E DAHWA

STRIDE
IGNOU
NEW DELHI, INDIA

March, 1998

Box. 1: Example of the title page of a research report

Note the other points mentioned on the cover page. Also observe the placement of these points.

ii) Preface including Acknowledgement

Preface is not a synonym for either a Acknowledgement or a Foreword. A preface should include the reasons why the topic was selected by the researcher. It may explain the history, scope, methodology and the researcher's opinion about the study. The preface and acknowledgements can be in continuation or written separately. This page follows the inner title page. It records acknowledgement with sincerity for the unusual help received from others to conduct the study. The acknowledgement should be non-emotional and simple.

iii) Table of Contents

A table of contents indicates the logical division of the report into various sections and subsections. In other words, the table of contents presents in itemized form, the beginning, the main body and the end of the report. It should also indicate the page reference for each chapter or section and sub-section on the right hand side of the table. Two sample tables of contents are given below:

1 Sample

TABLE OF CONTENTS

Box.2 Sample table of the contents

You must have noticed that no chapter is titled as Result or Findings. The alternative chapterization could have been as follows:

Chapter 1	Introduction
Chapter 2	Review of Related Literature
Chapter 3	Design and Methodology of the Study
Chapter 4	Results
Chapter 5	Interpretation of Results
Chapter 6	Summary & Conclusion

II Sample

TABLE OF CONTENTS

Box.3 Sample table of the contents.

iv) List of Tables

The table of contents page is followed by the page containing a list of tables. The list contains the exact title of each table, table number and the page

number on which the table has appeared. We provide you in Box.4 an example of a list of tables.

LIST OF TABLES

Box. 4 Example of a list of tables
Source: National Action Plan: UNESCO, 1996.

Box. 4, you will notice that all the content words start with a capital letter.

v) List of Figures and Illustrations

The page 'List of Figures' comes immediately after the 'List of Tables' page. You will observe in the following example that the list of figures is written in the same way as the list of tables.

LIST OF FIGURES

Box. 5 Example of a list of figures
Source: National Action Plan: UNESCO, 1996.

vi) Glossary

A glossary is a short dictionary, explaining the technical terms and phrases which are used with special connotation by the author. Entries of the technical terms are made in alphabetical order. A glossary may appear in the introductory pages although it usually comes after the bibliography. An exemplar glossary is given below.

GLOSSARY

Algorithm.	A step-by-step procedure consisting of mathematical and/or logical operations for solving a problem.
Artificial Intelligence (AI).	The study of computer techniques that mimic certain functions typically associated with human intelligence.
Back-up.	Duplication of a program or file on to a separate storage medium so that a copy will be preserved against possible loss or damage to the original.
Benchmark.	A measured point of reference from which comparisons of any kind may be made, often used in evaluating hardware and software, in comparing them against one another.
Command.	An instruction to the computer which is not a part of a program.
Cybernetics.	The field of science involved in comparative study of the automatic control or regulation of, and communication between machine and man. These studies include comparisons between information-handling machines and the brains and nervous systems of animals and humans.
Data.	Input to a computer which is processed by mathematical and logical operations so that it can ultimately be output in a sensible form.
Data Processing.	The input, storage, manipulation and dissemination of information using sequences of mathematical and logical operations.

Electronic Spreadsheet.	Software that simulates a worksheet in which the user can indicate data relationships. When data are changed, the program has the ability to instantly recalculate any related factors and to save all the information in memory.
Graphics Package.	A programme that helps draw graphs.
Hard Copy.	Output of information in permanent form, usually on paper, as opposed to temporary display on a CRT screen.
Ink Jet Printer.	A type of printer in which dot matrix characters are formed by ink droplets electrostatically aimed at the paper surface.
Laser Printer.	A printer that uses a laser beam to form images on photo-sensitive drums. Laser printers are now used as output devices for computers.
Megabyte (MB or M-Byte).	1024 kilobytes, or 1024 × 1024 bytes.
Personal Computer.	A moderately priced, general use computer designed principally for a single user in a home or small-office environment.

Source : Balagurusamy E : Selecting and Managing Small Computers.

(vii) List of Abbreviations italics

To avoid repeating long names again and again, a researcher uses abbreviations. Since abbreviations are not universal, it is necessary to provide the full form of the abbreviations in the begining. An exemplar list of abbreviation is given below.

ABBREVIATIONS

AIMA	All India Management Association
AIR	All India Radio
APPEP	Andhra Pradesh Primary Education Project
AVRC	Audio Visual Resource Centre
ATI	Administrative Training Institutes
BEL	Bharat Electronics Limited
BEO	Block Education Officer
BRC	Board Resource Centre
BSE	Board Of Secondary/Senior Secondary Education
CABE	Central Advisory Board of Education
CBT	Computer Based Training
CEO	Circle Education Officer
CIET	Central Institute of Educational Technology
CRC	Cluster Resource Centre
CSS	Centrally Sponsored Scheme
DIET	District Institute of Education and Training
DIT	District Institute of Training
DD	Doordarshan
DOE	Department of Electronics

DoSpace	Department of Space
DOT	Department of Telecommunications
DPEP	District Primary Education Program
DPEPII	District Primary Education Program : Phase II
EFA	Education for All
EMRC	Educational Media Resource Centre

Activity

Take any report which has been prepared by your institution and check whether the title page contains all the essential information. If not, try to fill in the gaps.

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Check Your Progress 1

List the major parts of the 'beginning' of a research report. Describe briefly the importance of each part.

Notes: (a) Space is given below for writing your answer.
(b) Compare your answer with the one given at the end of the unit.

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3.4 THE MAIN BODY

The main body of the report presents the actual work done by an investigator or a researcher. It tells us precisely and clearly about the investigation/study from the beginning to the end. The methodology section of the final report should be written in the past tense because the study has been completed. The report categorically avoids unnecessary details and loose language — we shall examine this point in detail in this section. At

this stage, you may again look at the Box on page 95. You will find that the table of contents for the report outlined of six sections/chapters in the main body. These are:

- Introduction
- Review of Related Literature
- Design of the Study
- Analysis and Interpretation of Data
- Main Findings and Recommendations
- Summary

Besides the logicality of sections/chapters in the main body there are certain other important aspects which need our attention. They are the style of writing, the design and placement of references and footnotes, the typing of the report, and the tables and figures.

Let us elaborate these points in the following sub-sections.

3.4.1 Chapters and their Functions

We will discuss the chapterisation of a thesis or a research report under six heads as noted above. Let us begin with introduction which is usually the first chapter.

Introduction

This is the first chapter of a thesis or a research report. It introduces the topic or problem under investigation and its importance. The introductory chapter :

- gives the theoretical background to the specific area of investigation,
- states the problem under investigation with specific reference to its placement in the broader area under study,
- describes the significance of the present problem,
- defines the important terms used in the investigation and its reporting,
- states precisely the objective(s) of the study,
- states the hypothesis/hypotheses of the study that would be tested through statistical analysis of data, [however, in philosophical and historical research there is no need to formulate and test a hypothesis, (see Block 2 of ES 315)], and
- defines the scope and limitations of the investigations.

Although these sub-sections are common, it is not necessary to follow the given order strictly; there may be variations in the order of the sub-sections. Sometimes the review of literature related to the area under investigation is also presented in the first chapter and is placed immediately after providing the theoretical background to the problem. Many researchers use review to argue the case for their own investigation. In experimental research it becomes essential to review related studies to formulate the hypotheses.

Review of related literature

The second chapter of a research report usually consists of the review of the important literature related to the problem under study. This includes the abstraction of earlier research studies and the theoretical articles and papers of important authorities in the field. This chapter has two functions. As you have read in Block 1, while selecting a problem area or simply a topic for investigation, the researcher goes through many books, journals, research abstracts, encyclopaedia, etc. to finally formulate a problem for investigation. The review of related literature is the first task for a researcher in order to decide on a specific problem for investigation. It also helps in formulating the theoretical frame work for the entire study. Secondly, such a review helps the researcher to formulate the broader assumptions about the factors/variables involved in the problem and later develop the hypothesis/hypotheses for the study.

Besides these, the review also indicates the understanding of the researcher in relation the area under investigation, and thus his/her efficiency to carry out the study. While reviewing literature in the area concerned, you have to keep in mind that the (reviewed) literature has to be critically analysed and summarised in terms of agreements and disagreements among the authors and researchers in order to justify the necessity for conducting your investigation. Researchers may make two types of errors in their review exercises. Many simply report the findings of one study after another in sequential order without showing how the findings are connected with one another. Others report on studies that are at best only marginally related to their own hypothesis.

Design of the study

The design of a study is usually described in the third chapter of the report. Broadly speaking, this chapter provides a detailed overview of "how" the study was conducted. The various sub-sections include:

i) description of the research methodology, i.e., – descriptive, experimental, etc.;
ii) variables: the dependent, independent and intervening variables with their operational definitions;
iii) sample: defining the population, and the sampling procedure followed to select the sample for the present study;
iv) listing and describing various tools and techniques used in the study, like questionnaires, attitude scales, etc., whether these have been adopted or developed by the investigator, their reliability, validity, item description, administration and scoring, etc.;
v) describing the statistical technique used in the analysis of data including the rationale of the use and method of data analysis. In philosophical and historical researches, for example, this type of sub-section may not be there.

Analysis and interpretation of data

This is the fourth chapter of the research report. It is the heart of the whole report, for it includes the outcome of the research. The collected data are presented in tabular form and analysed with the help of statistical techniques — parametric and non-parametric. The tables are interpreted and if necessary, the findings are also presented graphically. The figures do not necessarily repeat the tables, but present data visually for easy understanding and easy comparison. Data may be presented in parts under relevant sections. The analysis of the data not only includes the actual calculations but also the final results. It is essential that at each stage of analysis the objective(s) of the study and their coverage is taken care of. This chapter also presents the details about the testing of each hypothesis and the conclusions arrived at. This gives the reader a clear idea regarding the status of the analysis and coverage of objectives from point to point.

Main findings and conclusion

This is usually the fifth chapter in a research report. The major findings of the study analysed and interpreted in the preceding chapter are precisely and objectively stated in this chapter. The fourth chapter contains such presentations as only a specialist or a trained researcher can understand because of the complexities involved; but in the fifth chapter the major findings are presented in a non-technical language so that even a non-specialist such as a planner or an administrator in the field can make sense out of them.

The main findings are followed by a discussion of the results/findings. The major findings are matched against the findings of other related research works which have already been reviewed in the second chapter of the report. Accordingly, the hypotheses formulated in the first chapter are either confirmed or discarded. In case the null-hypotheses are rejected, alternative hypotheses are accepted. If the findings do have any discrepancy in comparison with those of other researches, or if the findings do not explain sufficiently the situation or problem under study, or if they are inadequate for generalisation, explanations with proper justification and explanation have to be provided.

The next task in this chapter is to provide implications of, the findings and their generalisations. The implications should suggest activities for and provide some directions to the practitioners in the field. Unless these implications are clearly and categorically noted, it becomes difficult for the practitioners to implement them on the one hand, and on the other research findings do not get utilised at all even if they have been recorded in a report.

The implications follow a presentation/listing of the limitations of the study on the basis of which suggestions are made to carry out further investigation or extend the study from where it has reached.

Summary

Some researchers include a summary along with the research report (as the last chapter) or as a pull-out to the report itself. It sums up precisely the whole of the research report right from the theoretical background to the suggestions for further study. Sometimes researchers get tempted to report more than what the data say. It is advisable to check this tendency and be always careful to report within the framework provided by the analysis and interpretation of data, i.e., within the limits of the findings of the study.

Check Your Progress 2

Comment briefly on the uses of (a) review of literature, and (b) conclusion in a research report.

Notes: (a) Space is given below for writing your answer.
(b) Compare your answer with the on given at the end of the Unit.

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3.4.2 Writing Style

The style of writing a research report is different from other writings. The report should be very concise, unambiguous, and creatively presented. The presentation should be simple, direct and in short sentences. Special care should be taken to see that it is not dull and demotivating.

Statements made should be as precise as possible — they should be objective and there should be no room for subjectivity, personal bias and persuasion. Similarly, over generalisation must by avoided. There is no place for hackneyed, slang and flippant phrases and folk expressions. The writing style should be such that the sentences *describe* and *explain* the data, but do not try to *convince* or *pursuade the reader*. Since the report describes what has already been completed, the writing should be in the past tense.

In the case of citations, only the last name of the author is used, and in all cases academic and allied titles like, Dr., Prof., Mr., Mrs., Ms. etc. should be avoided. Some authors recommend that the use of personal pronouns like "I", "We" etc., should be avoided. There is however no hard and fast rule

in this case. Similarly, a large number of research reports use passive voice which is strongly discouraged by the linguists. Similarly, abbreviations of words and phrases—like IGNOU, DDE, NIRD, etc.—should be used to avoid long names repeatedly inside the text, as well as in figures, tables, and footnotes.

Special care should be taken while using quantitative terms in a report, such as *few* for number, *less* for quantity etc. No sentence should begin with numericals like "40 students", instead it should start as "Forty students". Commas should be used when numbers exceed three digits—1,556 or 523,489, etc.

Language, grammar and usage are very important in a research report. The *Roget's Thesaurus, Handbook of Style* by Campbell and Ballon (1974), and a good dictionary would be of much help. MS-Word software provides good support to

- Spelling and Grammar
- Thesaurus
- Auto Correct
- Auto Summarise

A researcher is advised to use these features on the MS-Word to make the report error free. It is always advisable to show the report to learned friends or language experts for correction before it is finally typed. Revision is an important feature of good report writing—even experienced researchers with many publications revise their reports many times before giving them for final typing.

3.4.3 Footnotes / In-text References

Articles, papers, books, monographs, etc. quoted inside the text should always accompany relevant references, i.e., the author and the year of publication e.g., (Mukherjee, 1988). If a few lines or sentences are actually quoted from a source, the page number too should be noted e.g., (Mukherjee, 1988: 120-124). Besides, full reference should be placed in the Reference section of the report (see sub-section 3.5.1 below). The usual, though traditional style of giving references is to place them as the footnotes on the relevant page(s). The footnotes are serialized inside the text and in the footnotes of each chapter. These days, footnotes are usually avoided. However, they perform many functions. They provide ready reference on the page of the text itself to avoid the botheration of consulting the references at the end of the report off and on. In certain cases, footnotes include explanatory statements, full form of the abbreviations, extra justifications with reference to a portion of the text that may be read by a reader if needed, i.e., if the text is not clearly understood. However, precision and necessity should be the main guidelines to bring in these types of footnote.

Footnotes, as noted earlier, may be serialised as 1, 2, 3, 4, etc., within a chapter or be inserted at the end of the sentence concerned in parentheses as (5:23) which implies reference number 5 and page number 23, the full reference of which is given at the end of the chapter or in the reference section at the end of the report. Footnotes are always double-spaced between each other, though each footnote is typed single-spaced. *Ibid.* in the footnote refers to the same work and the reference that precedes it. For example, consider the following references:

[5]John, W. Best, *Research in Education* (New Delhi: Prentice Hall of India, 1993), p.146.
[6]Ibid. P.146 (This indicates *the same work* and the same page as above)
[7]Ibid. P.148 (This indicates *the same work* as above but a different page).

Ibid. in Latin means *the same. op. cit.* (in Latin means *the work cited*) is used in a footnote when another reference to the same work is made on the same page but not consecutively. Consider the following example:

[3]Frend N. Kerlinger, *Foundations of Behavioural Research*, New York: Holt, Rinehart & Winston, 1973, p.256.

[4]William G. Campbell and Stephen V. Ballon, *Form and Style: Theses, Reports, Term Papers,* Boston: Houghton Mifflin Co., 1974, p.15.

[5]Kerlinger, *op.cit.,* p.258.

Reference '5' is the same as reference '3', except that the page references differ in the two cases.

In case there are more references to the text on the same page of the original text which has been listed once, they may be listed/entered by the abbreviation loc. cit.

Example: [6]Campbell and Ballon, *loc. cit.*

Footnote is also a feature of MS-Word 97, under the pull-down menu of 'Insert'. It allows serialisation as well as customised footnote symbols. The menu can be used to make footnotes error free.

In preparing the footnote references, another factor to be considered is the abbreviations of words and expressions and their right placement. While writing a research report, abbreviations may be used to conserve space in references or footnote references. If a researcher is not familiar with the abbreviations, he/she should consult the relevant literature as and when required. In the following table (Table 1) a comprehensive list of abbreviations has been given for ready reference (the Latin abbreviations have been italicised).

Table I List of some important abbreviations used in footnotes and bibliographies

Words	Abbreviations
About (approximate date)	*c. (circa)*
Above	*supra.*
And the following	*et seg.*
And the following	*f., ff.*
And others	*et. al.*
Article, articles	art., arts.
Article, articles	*infra.*
Book, books	bk., bks.
Chapter, chapters	chap., chaps.
Column, columns	Col., Cols.
Compare	*cf.*
Division, divisions	div., divs.
Editor, editors	ed., eds.
Edition, editions	ed., eds.
For example	*e.g.*
Figure, figures	fig., figs.
Here and there (scattered)	*passim*
Illustrated	Ill
Line, lines	l. ll.
Manuscript	ms.
Mimeographed	mimeo.
No date given	n.d.
No name given	n.n.
No place given	n.p.
Number, numbers	no., nos.
Page, pages	p., pp.
Part, parts	pt., pts.
Paragraph in length	(....)
Paragraph, paragraphs	par., pars.
Previously cited	*op. cit.*
Revised	rev.
Same person	*idem.*
Same reference	*ibid.*
Section, sections	sec., secs.
See	*vide.*
The place cited	*loc. cit.*
Thus	*sic.*
Translated	trans.

3.4.4 Typing and Production

Typing of dissertations, research reports, project reports etc. needs greater care than other typed documents. In a research report, one does not expect overwriting, strikeovers, erasures and insertions.

Before typing the report, it is necessary to check whether the handwritten report, i.e., the manuscript is in a proper shape. Whether the manuscript of the report is typed by a typist or by the researcher himself/herself, a clear and comprehensible manuscript makes typing easy. Too many additions and corrections make the manuscript crammed, and a crammed manuscript makes typing difficult and time consuming. Only one side of the paper

should be typed and typing should be double spaced. Space should be left on each side of the paper as follows:

- left side margin
- right side margin
- top margin
- bottom margin

If there is a lengthy quotation, it should be indented and typed in single space. At the end of each line, words should be divided as per convention. A dictionary which shows syllabification should be consulted if words are to be broken at all. Unlike the lengthy quotations, short quotations of three/four lines may be included in the text within quotation marks.

Subject to access to a computer and word processing software, it is better to prepare the report on a computer. It has several advantages, for example, you can

- edit time and again without incorporating new errors which is what happens when you use a manual typewriter,
- define your margin – top, bottom, left and right easily,
- define pages in landscape or portrait size, particularly for tables and diagrams,
- choose out of about 70+ fonts – shapes of letters and type sizes from the smallest 8 point to the large 72 point,
- check spelling, grammar, synonyms and antonyms,
- choose illustrations from the clip-art file, and
- can index (alphabetical order) the references automatically.

If you happen to have access to Excel, it can automatically produce graphs and charts that can be transferred to Word document. For details of the use of Word and Excel for preparing research reports please refer to Units 2 and 3 of Block 5.

Finally, the computer output can be taken out in a Dot Matrix, Ink Jet or Laser printer. The Ink Jet and Laser Printers are the current standard in the market. They produce quality printouts that make reading easy.

3.4.5 Tables and Figures

Tables: Preparation and appropriate placement of tables in the text are equally important. They need careful attention from the researcher. Tables help the readers to get a quick view of the data and comprehend vast data at one go. However, tables should be presented only when they are necessary. Too many tables may confuse the reader, instead of facilitating his/her reading. As such you need to be selective in placing tables in the report.

If data are too complicated to be presented in one table, several tables may be used to give a clear picture of the data in proper sequential order. Tables, if small, may accompany the textual material, and if large, should be put on one full page without mixing them with the text. All the tables should be numbered serially in the text, so that they may be quoted or referred to with the help of those numbers conveniently.

If a table is large, it should continue on the next page with the table title repeated on the top of the next page; otherwise, tables can be typed in smaller fonts like 8pt. or 9pt. The table itself is centred between the two margins of the page, and its title typed in capital letters and is placed in pyramid size and preferably numbered in capital Roman numerals like I, II, III etc. The title of the table should be brief but self-explanatory.

Figures: Figures are necessary when the data is to be presented in the graphic form. They include charts, maps, photographs, drawings, graphs, diagrams, etc. The important function of a figure is to represent the data in a visual form for clear and easy understanding. Textual materials should not be repeated through figures unless very necessary.

Figures should be as simple as possible and the title of each figure should precisely explain the data that has been presented. Usually, a figure is accompanied by a table of numerical data. Again, figures are presented only after textual discussion and not the other way round. The title design of figures should be followed consistently throughout the report. Every first letter of a word of the title should be in capitals, and figures should be numbered in Indian numerals like 1, 2, 3 etc. And the title, unlike for tables, is presented below the figure.

3.5 THE END

The end of the report consists of references and an appendix/appendices. References come at the end after the last chapter of the report. The last section labelled references appears at the top of a new sheet of paper. The reference section is a list of the works that have been cited in the report/thesis. All references quoted in the text are listed alphabetically according to the last name of the authors. The works of the same author should be listed according to the date of publication with the earliest appearing first. It is different from a footnote in the sense that the latter is a specific reference to only one or more citations on a particular page.

3.5.1 Bibliography and References

Research reports present both bibliographies and references. Although many researchers use these terms interchangeably, the two terms have definite and distinct meanings. A bibliography is a list of titles – books, research reports, articles, etc. that may or may not have been referred to in the text of the research report. References include only such studies, books

or papers that have been actually referred to in the text of the research report. Whereas research reports should present references, books meant for larger circulation may be listed in bibliographies that should include all such titles as have been referred to.

There are mainly two style manuals detailing general form and style for research reports. These are:

- American Psychological Association, *Publication Manual*, 3rd ed. Washington, DC: American Psychological Association, 1983.
- *The Chicago Manual of Style*, 13th rev.ed., Chicago University of Chicago Press, 1982.

Style of Referencing

There are mainly two types of referencing:

1. arranging references in alphabetical order where the researcher has cited the name of the author and the year of publication/completion of the work in the text.
2. arranging references in a sequence as they appear in the text of the research report. In this case, related statement in the body of the text is numbered.

However, most research reports use alphabetical listing of references.

For example, entries in a reference section may look like the following:

1. Gannicott, K. and Throsby, D., *Educational Quality and Effective Schooling*, Paris: UNESCO, 1994 (Book).

2. Koul, B.N., Singh, B. and Ansari, M.M., *Studies in Distance Education,* New Delhi: IGNOU & AIU, 1988.

3. Kumar, K. L., *Educational Technology*, New Delhi: New Age Publishers, 1995.

4. Ministry of Human Resource Development, *DPEP: Guidelines*, Department of Education, MHRD, Government of India, New Delhi, 1995.

5. Mukhopadhyay, M. (ed.), *Educational Technology: Challenging Issues*, New Delhi: Sterling Publishers, 1990. (Edited Book)

6. Mukhopadhyay M., "Teacher Education and Distance Education: The Artificial Controversy", in Buch, Piloo M., (ed.) *Contemporary Thoughts on Education*, Baroda: SERD, 1998. (Chapter in Book)

7. Parhar, M., Impact of Media on Student Learning, Unpublished Doctoral Dissertation, New Delhi: Jamia Millia Islamia, 1993. (Thesis)

8. Sachidananda, Tribal Education: New Perspectives and Challenges, *Journal of Indian Education*, New Delhi: NCERT, 1994. (Article in a Journal)

9. Selltiz, Claire et. al., *Research Methods in Social Relations*, New York: Holt, Rinehart & Winston, 1959.

10. Dhanarajan, Gajaraj, "Access to Learning and Asian Open Universities: In Context" in the 12th Annual Conference of Asian Association of Open Universities, "*The Distance Learner*", The Open University of Hong Kong, Hong Kong SAR, China, 4-6 Nov., 1998 (Conference Paper).

You would notice the following:

- All studies are arranged in alphabetical order.
- The names of the authors are recorded by title and initials (not full name).
- To indicate two or three authors, 'and' is used between the first and the second, ',' between first and second and 'and' between second and third author.
- In case of more than three authors, only the name of the first author is mentioned followed by et al. (et allibi) or others.
- In case of a chapter in a book, after the author and chapter title and the name of the author or editor of the book.
- Titles of printed books, names of journals are highlighted by using 'italics' or by underlining (in case of manually typed material).
- Place of publication of a book precedes the name of the publisher separated by a ':' (colon).
- Names of journals are followed by the relevant volume and issue numbers usually in the form 10(3) – Volume 10, Number 2 and page numbers.
- Unpublished thesis or dissertation titles are not highlighted and the word 'unpublished' is mentioned.

The sequential referencing is done in the same way as indicated in the footnote earlier. For your convenience, the footnote example is rearranged in the form of referencing in format given below. However, this form of referencing and footnotes do not go together.

1. John, W. Best, *Research in Education* (New Delhi: Prentice Hall of India, 1993), p.146.
2. Ibid. P.146 (This indicates the same work and the same page as above)
3. Ibid. P.148 (This indicates the same work as above but a different page).
4. *Ibid.* in Latin means the *same. op. cit.* (in Latin means *the work cited*) is used in footnotes when another reference to the same work is made on the same page but not consecutively. Consider the following example:

5. Frend N. Kerlinger, *Foundations of Behavioural Research*, New York: Holt, Rinehart & Winston, 1973, p.256.
6. William G. Campbell and Stephen V. Ballon, *Form and Style: Theses, Reports, Term Papers* Boston: Houghton Mifflin Co., 1974, p.15.
7. Kerlinger, *op.cit.*, p.258.
8. Reference '5' is the same as reference '3', except that the page references differ in the two cases.

In case there are more references to the same page of the original text which has been listed once, they may be listed/entered by the abbreviation loc. cit.

Example: Campbell and Ballon, *loc. cit.*

Referring Web Based Documents

Computers have brought revolution in all sectors of development including education. Computers were conventionally used for data storage, processing and retrieval. Through Internet, information can be accessed from any part of the world.(Refer course ES-318, Block 5, Unit 3 to get more details on Computer and Internet). As researchers, reviewing the relevant literature related to the problem understudy is almost magnum opus. These days Internet is a rich academic and professional resource . World Wide Web (WWW) is the easiest and most popularly used browsing mechanism on the Internet. Here we will very briefly explain as how to write the references when we quote from any Web Site.

Citing E-Mail

E-Mail communications should be citied as personal communications as noted in APA's publication Manual http://www.apa.org/journals/webref.html. Personal Communications are not cited in the reference list. The format in the text should be as:
Sanjaya Mishra (personal communication, November 15, 2000).

Citing a Web Site

When you access the entire Web site (not a specific document on the site), you just give the address of the site in the text. It is not necessary to enter in the reference section.

For example,

http://www.ignou.org (IGNOU's website)
http://www.webct.com/ (This site provides tools for development of web based courses)

Citation of specific document on a web site has a similar format to that for print. Here we give few examples of how to cite documents. The Web information is given at the end of the reference section. The date of retrieval

of the site should be given because documents on the Web can change in content or they may be removed from a site.

Example

Duchier, D. (1996), Hypertext, New York: Intelligent Software Group. [Online] http://www.isg.sfu.ca/~duchier/misc/hypertext_review/chapter4.htm]Accessed on 25/1/99].

Flinn, S. (1996) Exploiting information structure to guide visual browsing and exploratory search in distributed information systems [Online] http://www.cs.ubc.ca/reading-room/[Accessed June 1998].

If you have to cite some specific parts of a web document, indicate the chapter, figure, table as required.

3.5.2 Appendices

Usually, the appendices present the raw data, the true copy of the tools used in the study, important statistical calculations, photographs and charts not used inside the text. These are ordered serially like Appendix-1, Appendix-2, or they can be serialized with capital letters (Appendix A, Appendix B) etc. to facilitate referencing within the text. The appendices provide reference facilities to readers and others interested in that particular field of investigation.

Activity

1. Take any report and check whether the references are written in the standard form. If not, try to rewrite them properly.

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2. Examine the appendices in the same report. Are all of them essential for the report. Comment.

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3.6 LET US SUM UP

In this Unit, we focused on research reporting as a professional activity. The purpose of writing the report depends on the reason behind undertaking the research study. It could be for obtaining a degree, or as a project report to be submitted to the funding agency, etc. Once submitted, the funding agency and the educational managers could utilise the findings and recommendations to achieve their objectives; other researchers may seek guidance from it; and lastly, the findings may be used for developing new theories in the discipline concerned.

A research report has three parts: the beginning, the main body and the end. The beginning includes: cover or the title page, acknowledgements, table of contents, the list of tables, and the list of figures. The main body normally contains an introduction, review of the relevant literature, objectives, hypotheses, research design (research methodology, population and sample, tools, procedure of collecting data), analysis and interpretation of data, the main findings and conclusion (that also includes its educational implications and suggestions for further studies). While discussing the main body, we have talked about the style of writing the report, style and placement of footnotes and references, the typing process and the format and placement of tables and figures. We closed the discussion with notes on the style, arrangement and placement of references and appendices which constitute the end of a research report.

3.7 CHECK YOUR PROGRESS: THE KEY

1. The major parts of the beginning of a research report are: cover/title page, acknowledgements, table of contents, list of tables, list of figures and list of abbreviations.

   The cover page gives us clear information about the subject/theme, author and the year of the research study as well as the organisation for which or where the study has been conducted.

   Acknowledgements are words of appreciation from the researcher for those who have helped him/her while conducting the study. Table of contents indicates the main themes/areas studied, the methodology followed and the outcome of the study.

   List of tables, figures and abbreviations are useful as reference tools.

2. a) Review of literature helps the researcher to specifically define the problem for investigation, decide about the usefulness of the study and formulate his/her hypothesis.

   b) The conclusion of a research report sums up the findings, states what is new in the report concerned and indicates the

direction for future studies as well as implications for implementation of recommendations, if any.

References

Campbell, W.G. and Steven, V. Ballon, Form and Style : Thesis, Reports, Term Pages, Honghtom Migglin C., 1974.

http://www.apa.org/journals/webref.html.