NETAJI SUBHAS OPEN UNIVERSITY

STUDY MATERIAL

M. Ed. Special Education
(Hearing Impairment / Intellectual Disability) - ODL

A 3

RESEARCH METHODOLOGY AND STATISTICS

M. Ed. Spl. Ed. (H.I. / I.D.)
ODL Programme

AREA - A

A 3: RESEARCH METHODOLOGY AND STATISTICS

A COLLABORATIVE PROGRAMME OF
NETAJI SUBHAS OPEN UNIVERSITY
AND
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AREA - A
DISABILITY SPECIALIZATION
COURSE CODE - A 3
RESEARCH METHODOLOGY AND STATISTICS

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The Self Instructional Material (SIM) is prepared keeping conformity with the M.Ed.Spl. Edn.(HI/ID) Programme as prepared and circulated by the Rehabilitation Council of India, New Delhi and adopted by NSOU on and from the 2020-2022 academic session.

Mohan Kumar Chattopadhyay
Registrar

Prologue

I am delighted to write this foreword for the Self Learning Materials (SLM) of M Ed in Special Education (ODL). The M Ed in Special Education in ODL mode is a new academic program to be introduced at this University as per NOC issued by the Rehabilitation Council of India, New Delhi and subject to approval of the program by the DEB-UGC.

I must admire the emulation taken by the colleagues from School of Education (SoE) of NSOU for developing the Course Structure, Unit wise details of contents, identifying the Content Writers, distribution of job of content writing, editing of the contents by the senior subject experts, making DTP work and also developing E-SLMs of all the 16 Papers of the M Ed program. I also extend my sincere thanks to each of the Content Writers and Editors for making it possible to prepare all the SLMs as necessary for the program. All of them helped the University enormously. My colleagues in SoE fulfilled a tremendous task of doing all the activities related to preparation of M Ed in Spl Edn SLMs in war footing within the given time line.

The conceptual gamut of Education and Special Education has been extended to a broad spectrum. Helen Keller has rightly discerned that *"Have you ever been at sea in a dense fog, when it seemed as if a tangible white darkness shut you in and the great ship, tense and anxious, groped her way toward the shore with plummet and sounding-line, and you waited with beating heart for something to happen? I was like that ship before my education began, only I was without compass or sounding line, and no way of knowing how near the harbour was. "Light! Give me light!" was the wordless cry of my soul, and the light of love shone on me in that very hour."* So education is the only tool to empower people to encounter his/her challenges and come over being champion. Thus the professional Teacher Education program in Special Education can only groom the personnel as required to run such academic institutions which cater to the needs of the discipline.

I am hopeful that the SLMs as developed by the eminent subject experts, from the national as well as local pools, will be of much help to the learners. Hope that the learners of the M Ed Spl Edn program will take advantage of using the SLMs and make most out of it to fulfil their academic goal. However, any suggestion for further improvement of the SLMs is most welcome.

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AREA - A

A 3 : RESEARCH METHODOLOGY AND STATISTICS

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A 3 ◘ RESEARCH METHODOLOGY AND STATISTICS

Unit-1 ◘ Scientific Knowledge & Research

Structure

1.1 Introduction:

There are many learning resources on how to do research but they tend to pay relatively little attention to the question of why we should do it. Let's reflect upon this for a moment by considering how some people might answer the question 'Why do you do research? Western academics might be perplexed by this question because for them it would be self-evident. It would be like asking them 'Why breathe'? If forced to answer, many would say that it is the very basis of their job. Some even see teaching as getting in the way of their duty to 'push back the boundaries of knowledge'. Others might describe research as a necessity for survival. This is because research, when coupled with publication in a book or reputable journal, is an important activity that has a great bearing on their status and promotion opportunities. Some might say that they need to do research because it informs and improves their teaching. Others might mention natural curiosity or their own desire to learn.

So the question 'Why do research?' can be answered in many different ways. The word 'why?' is so broad that answers can legitimately vary from 'in order to get promoted' to 'to increase the sum of knowledge'; from 'because I was told to' to 'in order to combat …..' etc.

Why do we do research in education? It may be put in this way, like: "It is committed to being evidence-based in the decisions we make, the policies we develop and the programs we implement". Good evidence includes the use of research and evaluation to inform our work. It plays an important role in developing, conducting, commissioning and communicating research connected to our priority goals.

Unfortunately, good quality education research does not always find its way into the hands of teachers and teaching assistants, other stakeholders who work in the classroom/Institutions, or to those who formulate education policy. Yet, we know that research can inform more effective practices that can result in improved student outcomes. Evidence from research and evaluation can also help to ensure resources are invested wisely and our future programs learn from the strengths and weaknesses of past approaches. Independent evaluation evidence also contributes to improving public confidence in the results we are achieving.

Good educational theory and practice rest on a strong foundation of new knowledge. Through research we can create new knowledge and/or even modify existing knowledge. In order to be effective, teachers need to test their methods of teaching and improve them in case they are not effective. In addition, most education systems in the world base educational policy on empirical investigations and quite often teachers are invited to participate in these investigations, which have contributed to their professional growth and improvement in their incomes. Therefore teachers need to have good research skills.

Wikipedia (2013) describes educational research as "a variety of methods, in which individuals evaluate different aspects of education including but not limited to: "student learning, teaching methods, teacher training, and classroom dynamics". Wikipedia continues:Educational researchers have come to the consensus that, educational research must be conducted in a rigorous and systematic way, although what this implies is often debated. There are a variety of disciplines which are each present to some degree in educational research. These include psychology, sociology, anthropology, and philosophy. The overlap in disciplines creates a broad range from which methodology can be drawn. The findings of educational research also need to be interpreted within the context in which they were discovered as they may not be applicable in every time or place.

Educational research is important because it is conducted in order to provide trustworthy information regarding educational problems and their solutions. There are many things that need to be considered when looking at what educational research is for example some thought needs to be put into looking at current paradigms, what counts as evidence in educational research, maintaining quality, and the role of peer review in validating new knowledge in educational research.

There are many different approaches to educational research which are shaped by many different research paradigms. Koul (2008) states that "the various research paradigms have different criteria for ontology and epistemology to maintain quality standards. The ontology and epistemology of a research paradigm influence researchers applying the quality standards, methodology and methods.

The following subunits have been logically discussed to gain an understanding of the overture to research methodology in Education and Special Education; relationship between epistemology, methodology and practice.

1.2 Objectives:

After going through this unit, the learners will be able to:

- identifythe different sources and philosophy of knowledge
- reflect in a critical way upon scientific thinking and research
- be familiar with the role of theory in research
- review and interpret the need of research in Education & Special Education
- explore the importance of ethics in research

1.3: Sources & Philosophy of knowledge:

1.3.1 Prelude:

This subunit clearly identifies the sources from which one acquires knowledge or justified belief. It distinguishes the "**four standard basic sources": perception, memory, consciousness, and reason.** A basic source yields knowledge or justified belief without positive dependence on another source. Nevertheless, **memory**, a basic source of justification, plays a preservative rather than a generative role in knowledge. After clarifying the relationship between a source and a ground, or "what it is in virtue of which one knows or justifiably believes". It examines the relationship of coherence to knowledge and justification, noting the distinction between a negative dependence on incoherence and a positive dependence on coherence.(OXFORD handbook, 2005). The Venn diagram below reflects on the sociology of knowledge as propounded by Plato:

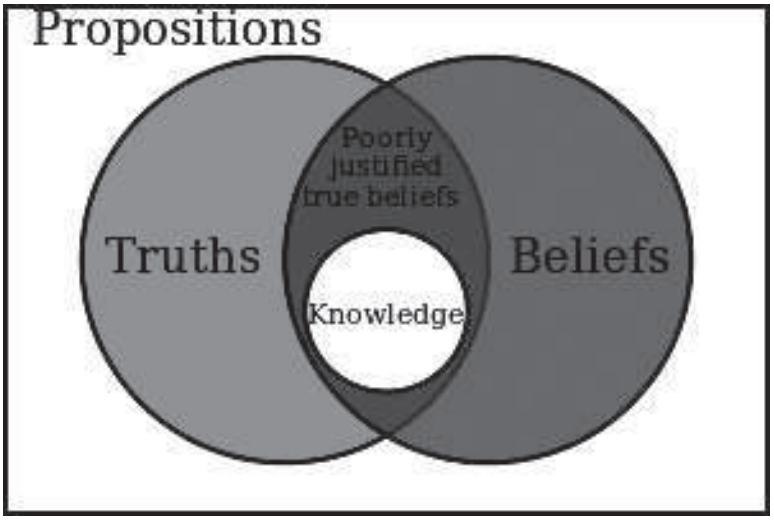

Fig: A Venn diagram simplification of Plato's definition of knowledge

Source: https://en.wikipedia.org/wiki/Sociology_of_knowledge

1.3.2 Epistemology:

First of all, you should realize that research is only one of several ways of "knowing."The branch of philosophy that deals with this subject is called Epistemology. Epistemologists generally recognize at least four different sources of knowledge:

1. Intuitive Knowledge takes forms such as belief, faith, intuition, etc. It is based on feelings rather than hard, cold "facts."

2. Authoritative Knowledge is based on information received from people, books, a supreme being, etc. Its strength depends on the strength of these sources.

3. Logical Knowledge is arrived at by reasoning from "point A" (which is generally accepted) to "point B" (the new knowledge).

4. Empirical Knowledge is based on demonstrable, objective facts (which are determined through observation and/or experimentation).

Hence, Research makes use of all four of these ways of knowing: Intuitive (when coming up with an initial idea for research); Authoritative (when reviewing the professional literature); Logical (when reasoning from findings to conclusions); Empirical (when engaging in procedures that lead to these findings)

Nevertheless, this last kind of knowledge, empirical knowledge, is what most modern research in education and its interdisciplinary domains of acquisition aims at establishing facts and facets. That is why we call it empirical research.

1.3.3 Brief description of the role of each source of knowledge in modern scientific research

1. The sources of new knowledge are authority, intuition, scientific empiricism, and an educated guess. Authority, intuition, and an educated guess are all sources of hypotheses, but scientific empiricism is the only source of new knowledge.

2. Intuition is knowledge that is gained through a feeling or thought that might turn out to be true. Authority is a source of knowledge that you gain from your parents, or a book that tells you that this is the way things are and that's that. Rational induction is a source of knowledge by reasoning and proofs. This type of knowledge comes about by supposing one thing and then giving a proof of it, or any other way you want to do a proof. Empiricism is knowledge gained through careful observation, manipulation of variables through the scientific method, repeating research designs, and taking in data to interpret. Empiricism is the accepted role of knowledge in psychological and educational research because psychologists use statistics and believe in probabilistic conclusion. That people behave generally in one way in most situations and using statistics to decide if two variables are related. Authority, intuition are not accepted sources of knowledge for socio-psychological research because they are not grounded in any source of statistics or observable facts.
3. Descriptive knowledge is useful in discriminating, measuring or defining different behaviors or characteristics. Predictive knowledge is useful in determining a statistical relationship between two behaviors or characteristics and whether they are related. Understanding is useful in determining whether changes in one behavior or characteristic influences changes in another behavior or characteristic.
4. Empirical Research is a scientifically conducted study when yields results which are causally interpretable. While rational induction is more logical thinking based on observation. Observation is the process of objectively viewing a situation and making inferences based therein. Empirical Research is the only way to attain fact in modern scientific psychological research. However, rational induction, observation and research are all valid ways to obtain a hypothesis.

The snapshot below clearly identifies the nature of more sources of knowledge:

Sources of Knowledge		IN REVIEW
SOURCE	DESCRIPTION	ADVANTAGES/DISADVANTAGES
Superstition	Gaining knowledge through subjective feelings, interpreting random events as nonrandom events, or believing in magical events	Not empirical or logical
Intuition	Gaining knowledge without being consciously aware of where the knowledge came from	Not empirical or logical
Authority	Gaining knowledge from those viewed as authority figures	Not empirical or logical; authority figure may not be an expert in the area
Tenacity	Gaining knowledge by clinging stubbornly to repeated ideas, despite evidence to the contrary	Not empirical or logical
Rationalism	Gaining knowledge through logical reasoning	Logical but not empirical
Empiricism	Gaining knowledge through observations of organisms and events in the real world	Empirical but not necessarily logical or systematic
Science	Gaining knowledge through empirical methods and logical reasoning	The only acceptable way for researchers/ scientists to gain knowledge

Source: https://ibave.weebly.com/uploads/1/0/7/4/10741354/applied_ research_ ibave1.pdf.

1.3.4 Vision of sources of Knowledge

There are many ways to gain knowledge, and some are better than others. Asat several ways of acquiring knowledge, beginning with sources that maynot be as reliable or accurate as scientists might desire. We will then considersources that offer greater reliability and ultimately discuss using science as ameans of gaining knowledge. Here you can see through another protracted vision of source of knowledge as discussed below:

1. Superstition and Intuition

Gaining knowledge via superstition means acquiring knowledge that isbased on subjective feelings, interpreting random events as nonrandomevents, or believing in magical events. For example, you may have heardsomeone say "Bad things happen in threes." Where does this idea come from? It is well known that, no study has ever documented as bad eventsoccur in threes, yet people frequently say this and act as if they believe it.Some people believe that breaking a mirror brings 7 years of bad luck orthat the number 13 is unlucky. Once again, these are examples of superstitiousbeliefs that are not based on observation or hypothesis testing. Assuch, they represent a means of gaining knowledge that is neither reliablenor valid.When we gain knowledge via intuition, it means that we have knowledge of something without being consciously aware of where theknowledge came from.

2. Authority

When we accept what a respected or famous person tells us, we are gainingknowledge via authority. You may have gained much of your own knowledgethrough authority figures. As you were growing up, your parentsprovided you with information that, for the most part, you did not question,especially when you were very young. You believed that they knew whatthey were talking about, and thus you accepted the answers they gave you.You have probably also gained knowledge from teachers whom you viewedas authority figures, at times blindly accepting what they said as truth. Mostpeople tend to accept information imparted by those they view as authorityfigures. Historically, authority figures have been a primary means ofinformation. For example, in some time periods and cultures, the religious Institutions and its leaders were responsible for providing much of the knowledge thatindividuals gained throughout the course of their lives.Even today, many individuals gain much of their knowledge from authorityfigures. This may not be a problem if the perceived authority figure truly isan authority on the subject. However, problems may arise in situations wherethe perceived authority figure really is not knowledgeable about the materialhe or she is imparting. A good example is the information given in "infomercials."Celebrities are often used to deliver the message or a testimonial concerninga product. These individualsmay be experts on acting or modeling, but they are not authorities on the productsthey are advertising. Yet many individuals readily accept what they say.It is seen that, accepting the word of an authority figure may be a reliableand valid means of gaining knowledge, but only if the individual istruly an authority on the subject. Thus, we need to question "authoritative"sources of knowledge and develop an attitude of skepticism so that we donot blindly accept whatever is presented to us.

3. Tenacity

Gaining knowledge via tenacityinvolves hearing a piece of information sooften that you begin to believe it is true, and then, regardless of evidence to thecontrary, you adhereobstinately to the belief. This method is often used inpolitical campaigns, where a particular slogan is repeated so often that webegin to believe it. Advertisers also use the method of tenacity by repeatingtheir slogan for a certain product over and over until people begin toassociate the slogan with the product and believe that the product meets itsclaims. The problem with gaining knowledge through tenacity is that we do notknow whether the claims are true. As far as we know, the accuracy of suchknowledge may not have been evaluated in any valid way.

4. Rationalism

Gaining knowledge via rationalisminvolves logical reasoning. With thisapproach, ideas are precisely stated and logical rules are applied to arrive ata logically sound conclusion. Rational ideas are often presented in the formof a syllogism.

For example:

1. All humans are mortal;I am a human;Therefore, I am mortal.This conclusion is logically derived from the major and minor premises in the syllogism.
2. Attractive people are good; Shyama is attractive;Therefore, Shyama is good.

Such syllogism should identify for you the problem with gaining knowledgeby logic. Although the syllogism is logically sound, the content of bothpremises is not necessarily true. If the content of the subject were true, thenthe conclusion would be true in addition to being logically sound. However,if the content of either of the subject is false (as is the subject "Attractivepeople are good"), then the conclusion is logically valid but empirically falseand therefore of no use to a researcher. Logic deals with only the form of thesyllogism and not it's content. Evidently, researchers are interested in bothform and content.

5. Empiricism

Knowledge via empiricisminvolves gaining knowledge through objectiveobservation and the experiences of your senses. An individual who says "Ibelieve nothing until I see it with my own eyes" is an empiricist. The empiricistgains knowledge by seeing, hearing, tasting, smelling, and touching.This method dates back to the age of Aristotle. Aristotle was an empiricistwho made observations about the world in order to know it better. Plato, incontrast, preferred to theorize about the true nature of the world withoutgathering any data.Empiricism alone is not enough, however. Empiricism represents a collectionof facts. If, as scientists, we relied solely on empiricism, we would havenothing more than a long list of observations or facts. For these facts to be useful,we need to organize them, think about them, draw meaning from them,and use them to make predictions. In other words, we need to use rationalismtogether with empiricism to make sure that we are being logical about theobservations that we make. As you will see, this is what science does.

6. Science

Gaining knowledge via science involves a merger of rationalismand empiricism. Scientists collect data (make empirical observations)and test hypotheses with these

data (assess them using rationalism). Ahypothesis is a prediction regarding the outcome of a study. This predictionconcerns the potential relationship between at least two variables (a variableis an event or behavior that has at least two values). Hypotheses are statedin such a way that they are testable. By merging rationalism and empiricism,we have the advantage of using a logical argument based on observation.We may find that our hypothesis is not supported, and thus we have toreevaluate our position. On the other hand, our observations may supportthe hypothesis being tested.In science, the goal of testing hypotheses is to arrive at or test a theory—an organized system of assumptions and principles that attempts to explaincertain phenomena and how they are related. Theories help us to organizeand explain the data gathered in research studies. In other words, theoriesallow us to develop a framework regarding the facts in a certain area.

Let us cite a very common example, Darwin's theory organizes and explains facts related to evolution.To develop his theory, Darwin tested many hypotheses. In addition to helpingus organize and explain facts, theories help in producing new knowledgeby steering researchers toward specific observations of the world (Gray, 2003).

1.4: Scientific thinking & Research:

1.4.1 Prelude:

The sources of knowledge and their philosophical underpinning engulf our sense of doing research. The previous subunit clearly presented before you the plethora of understanding the ways of knowing as prerequisite for undertaking research. Such understanding paves way for the next level: scientific thinking in setting the stage for research.

Research is the systematic and objective analysis and recording of controlled observations that may lead to the development of generalization principles or theories resulting in prediction and possibly ultimate control of events. Scientific research is a systematic and objective attempt to provide answers to certain questions. It is an essential and powerful tool in leading towards progress.

1.4.2 Premises

A significant research leads to progress in some field of life. Research is born out of human curiosity. We can also conceive the term research as a scientific thinking,

unbiased investigation of a problem, based insofar as possible upon demonstrable facts and involving refined distinction, interpretations and usually some generalizations. Since it is a continuous problem solving approach to learning, it aims and assists in achieving the goals through analysis and comprehensive investigation. A scientific thinking in research elicits the following key premises:

1. An outlook of enquiry
2. An effort to draw out facts
3. A systematic and scholarly application of the scientific method
4. Essentially a state of mind-a friendly, welcoming attitude towards change

Now that we have briefly described what scientific research or thinking is, let's discuss how this applies to the discipline of educational research. Science is the manner in which something is studied. Science is a way of thinking about and observing events to achieve a deeper understanding of these events. Educationists/ researcher apply the scientific method to their study of human beings and other animals. The scientific method involves invoking an attitude of skepticism. A skepticis a person who questions the validity, authenticity, or truth of something purporting to be factual. In our society, being described as a skeptic is not typically thought of as a compliment. It means that you do not blindly accept any new idea that comes along. Instead, the skeptic needs data to support an idea and insists on proper testing procedures when the data were collected. Being a skeptic and using the scientific method involve applying three important criteria that help define science: systematic empiricism, publicly verifiable knowledge, and empirically solvable problems (Stanovich, 2007).

Scientific research should be publicly verifiable knowledge.This means that the research is presented to the public in such a way that it can be observed, replicated, criticized, and tested for veracity by others. Most commonly, this involves submitting the research to a scientific journal for possible publication. Most journals are peer-reviewed—other scientists critique the research to decide whether it meets the standards for publication. If a study is published, other researchers can read about the findings, attemptto replicate them, and through this process demonstrate that the results are reliable. You should be suspicious of any claims made without the

support of public verification. For example, many people have claimed that they were abducted by aliens. These claims do not fit the bill of publicly verifiable knowledge; they are simply the claims of individuals with no evidence to support them. Other people claim that they have lived past lives. Once again, there is no evidence to support such claims. These types of claims areUnverifiable—there is no way that they are open to public verification.

Science always investigates empirically solvable problems—questions that are potentially answerable by means of currently available research techniques. If a theory cannot be tested using empirical techniques, then scientists are not interested in it. For example, the question "Is there life after death?" is not an empirical question and thus cannot be tested scientifically. However, the question "Does an intervention program minimize behavioural disorder in juvenile delinquents?" It can be empirically studied and thus is within the realm of science. When empirically solvable problems are studied, they are always opento the principle of falsifiability—the idea that a scientific theory must be stated in such a way that it is possible to refute or disconfirm it. In other words, the theory must predict not only what will happen but also what will not happen. A theory is not scientific if it is irrefutable. This may sound counterintuitive,and you may be thinking that if a theory is irrefutable, it must be really good. However, in science, this is not so. Scientific temperament elicits to ask 'WHY' always rather than readily accepting facets. Another concept come to play here is Pseudoscience.

1.4.3 Pseudoscience:

It is usually irrefutable and is also often confused with science. For example, those who believe in extrasensory perception(ESP, a pseudoscience) often argue with the fact that no publicly verifiable example of ESP has ever been documented through systematic empiricism .Hence, those who believe in ESP have setup a situation in which they claim falsifying data are not valid, the theory of ESP violates the principle of falsifiability.You may be thinking that the explanation provided by the proponents of ESP makes some sense to you. But it is a wrong notion and cannot be verified through science and sense altogether. The snapshot below is a bottled up scientific thinking and research in psychological and educational studies:

The Scientific Approach		IN REVIEW
CRITERIA	**DESCRIPTION**	**WHY NECESSARY**
Systematic empiricism	Making observations in a systematic manner	Aids in refuting or developing a theory in order to test hypotheses
Publicly verifiable	Presenting research to the public so that it can be observed, replicated, criticized, and tested	Aids in determining the veracity of a theory
Empirically solvable	Stating questions in such a way that they are answerable by means of currently available research techniques	Aids in determining whether a theory can potentially be tested using empirical techniques and whether it is falsifiable

Source: https://ibave.weebly.com/uploads/1/0/7/4/10741354/applied_research_ibave1.pdf.

1.5: Role of Theory in Research:

1.5.1 Purpose of Scientific research:

The purpose of science is to expand knowledge and discover the truth. By building theory, researchers undertake research to achieve this purpose. Prediction and understanding are the two purposes of theory and they usually go hand in hand. To make a prediction, one must know and understand why variables behave as they do and theories provide this explanation. A theory is a coherent set of general propositions used as principles to explain the apparent relationships of certain observed phenomena. The scientific method is a series of stages used to develop and refine theories. Scientific methods and scientific thinking are based on concepts. Concepts are invented so as to enable us to think and communicate abstractions. Higher-level concepts are used for specialised scientific explanatory purposes that are not directly observable. Concepts and constructs are used at the theoretical levels while variables are used at the empirical level. The scientific research process is used to develop and test various propositions using inductive-deductive reflective thinking. Scientific research uses an orderly process that combines induction, deduction, observation and hypothesis testing into a set of reflective thinking activities. People analyse problems differently because they have selective perception and conditioning of the environment affecting them; the kind of questions asked would be different depending on how they see the world. Scientific inquiry is one of the ways to analyse problems. Understanding the relationship between science and research will help researchers in formulating the study.

1. A belief that theory is universal and law-like generalisations can be made across contexts,
2. The assumption that context is not important
3. The belief that truth or knowledge is 'out there to be discovered' by research,
4. The belief that cause and effect are distinguishable and analytically separable,
5. The belief that results of inquiry can be quantified,
6. The belief that theory can be used to predict and to control outcomes
7. The belief that research should follow the Scientific Method of investigation
8. Rests on formulation and testing of hypotheses
9. Employs empirical or analytical approaches
10. Pursues an objective search for facts
11. Believes in ability to observe knowledge.
12. Application of the scientific method

The researcher's ultimate aim is to establish a comprehensive universal theory, to account for human and social behaviour. Let us throw light on the theory in the purview of research discourse: its concept, components and need.

1.5.2 Theories and Research

Before we can explore the two major categories of research, educational leaders must first understand how their research questions are impacted by theory or how they result in theory. Driscoll (2005) states a "theory about learning is a set of laws or principles about learning". She goes to ask "But what do these principles involve? What is their purpose? Andwhere do they come from?"

Driscoll goes on to say, "Regardless of how questions arise, they generally lead researchers to conduct systematic observations on the basis of which plausible answers can be constructed. In some kinds of investigations, these observations are conducted without many advance or a priori expectations about what will be seen ……. But contrast other kinds of investigations require the researchers to generate and test potential answers to the research questions."

These potential answers are governed by hypothesis about the different events or variables acting upon the observed event. Driscoll continues to say "in order to examine the viability of hypothesis a set of particular observations must be conducted".

This requires clearly defined methods of observing, collecting data, analysing data and measuring the results. Two major types of research exist to examine educational questions depending on the types of questions you ask, the hypothesis that you have proposed and the methods of analysing the data: Quantitative, Qualitative Research and Mixed method research.

1.5.3 Revealing concepts

Here, in this sub unit, you will not find an elaboration of types of research. Let us reflect upon and examine a few revealing concepts:

1. Theory: It is a set of interrelated constructs or concepts, definitions and propositions that presents a systematic view of phenomena by specifying relations among variables. A theory is used to explain or predict phenomena and can be tested for validity and reliability. A theory that is proven often involves into one or models.

2. Hypothesis: It is a statement used to help clarify the research question. It is presented as a declarative statement of prediction and is in the form of either a null hypothesis or a directional hypothesis. The null hypothesis predicts no change or no difference. The directional hypothesis predicts a difference and the direction of that difference. Statistical methods are used to measure the hypothesis.

3. Variables: They are in research something that can be measured or observed upon to determine its impact on the hypothesis. Variables can include such things gender, age, education, weight, geographic location, motivation, economic status and other factors impacting on those groups being observed or measured.

*4 Models***:** They are paradigms that describe the overall framework that is based on theory and is used to look at the situation being researched. Models consist of concepts and principles that have proven valid and help impose meaning on the world being observed. Models help classify and predict actions.

The subsequent section intends to dwell on theory and its place in research.Theory comprises systematically interrelated concepts, definitions andpropositions that are used to explain and predict phenomena (facts). It is asystematic explanation for the observation that relates to a particular aspect ofbehaviour. All operations are carried out on the basis of theories since theoriesare general statements about variables and the relationships among them. Thesegeneralisations are used to make decisions and predict outcomes.

1.5.4 Purpose:

Theory serves many useful purposes in research:

1. It narrows the range of facts needed to study; any problem can be studied in many different ways.
2. A theory can suggest the ways that are likely to yield the greatest meaning;
3. It suggests a system for the researcher to impose on data in order to classifythem in a meaningful way;
4. It summarises what is known about an object;
5. It indicates uniformities that are not immediately observable; and
6. It helps to predict future facts that could be found.

1.5.5 Components of Theory:

The followings are the components of theory:

1. **Concepts**: A concept is a bundle of meanings or characteristics associated with certain

   events, objects, conditions and situations. Concepts may be developed because of frequent, general and shared usage over time. It may be acquired through experience. Some concepts are unique to a particular culture and not easily translated into another language. In research, concepts used must be precise and comprehensible; hypotheses are designed using concepts, measurement concepts are used to collect data, new concepts may be invented to express ideas. The success of research depends on the ability of researchers to conceptualize ideas and how well others understand the concepts used. Concepts represent progressive levels of abstractions; the degree to which the concepts do nothave objective referents. A shirt is an objective concept while personality isa concept with a high degree of abstraction; such concepts are called constructs.

2. **Constructs:** A construct is an image or idea specifically invented for a given research and/or theory-building purpose. Constructs are developed by combining simpler concepts, especially if the idea or image we want to convey is not directly subject to observation. Intelligent quotient (IQ) is constructed mathematically from observations of the answers given to a large number of questions in an IQ test. No one can directly or indirectly observe IQ but it is a real characteristic of people.

3. **Definitions:** If the meaning of the concept is confused, the value of the research may be destroyed. If the concepts used give different meanings to

different people it indicates that the parties are not communicating on the same wavelength. A concept may be defined with a synonym. For research purposes, the definition must measure concepts, thus, needing a more rigorous definition. Operational definition is a definition stated in terms of specific testing criteria or operations; the terms must have empirical referents (must be able to count, measure or gather information in an objective manner). The definition must specify the characteristics to study and how to observe the characteristics. An effective operational definition ensures that two or more people will have the same interpretation of a phenomenon. The purpose of operational definition is basically to provide unambiguous interpretation and measurement of concepts.

4. **Variables:** At the theoretical level, constructs and concepts are used to relate to propositions and theory; at this level, constructs cannot be observed. At the empirical level, propositions are converted into hypotheses and tested; at this level, the concepts are termed as variables. The term variable is used as a synonym for construct or the property being studied. They are of different types and indicator of the degree of level of assumptions and hypotheses.

5. **Model:** A model is a representation of a developed system used to study some aspects of the system or the system as a whole. It is different from theory because theory explains relationships in the system whereas a model is a representation of the relationships in the system.

6. **Framework:** A framework is an abstract representation of a phenomenon. It describes the variables studied and the relationships among the variables. It can be represented graphically in a diagram. Thus, in the early stage of a research, a theoretical framework is usually constructed based on initial studies or literature search. The theoretical framework is used to explain the relationships that need to be investigated and tested in research. A framework that has been successfully tested will be considered as the final framework. A research will report the research findings by presenting the final framework.

7. **Process:** A process is developed for a specific purpose in a business organisation. It aims to make some change in the organization. In research, a process is developed to help solve an organization's problem or improve its performance. The output of research will be in the form of a new process

rather than a framework or model. A process is also called a tool, procedure, method or system.

1.6: Need for Research in Education & Special Education:

1.6.1 Backdrop:

Conducting Educational Research requires knowledge of the scientific process and a variety of research tools and techniques. What research you do, how you do it, and what happens to the results will depend to a large extent upon the social situation and educational environment you find yourself in. There will be many direct influences that relate to your own position as a researcher in the decision-making structure. As you progress through the course you will learn to consider your own personal values, and how to examine the education, economic, labour and other variables that impact your research process and findings (Cred, C., Freeman, R. Robinson, B. & Woodley, A. (n.d.).

Education is constantly evolving, with educators and educational theorists involved in an ongoing search for innovative and effective methods and teaching strategies to meet the unique needs of each student. Such temperament and approach is perhaps most essential in special education and the inclusive classroom.

Social science, including research into special educational needs, purports to be with intent, and much of special needs research falls into the empirical analytic paradigm which regards human affairs as containing measurable, law like qualities to be identified and manipulated. Nonetheless, some regard this may be a flawed assumption and that all researchers need to be aware of the potentially political nature of their position. The sources, for instance, of a physical disability need to be located, not in the physical problem per se, but within the way society seeks to deal with it. Although researchers may like to view themselves as impartial seekers of the truth, it is suggested that research techniques themselves emerge from a theoretical position which reflects their beliefs, values and dispositions towards the world. (Gray & Denicolo, 2003).

1.6.2 Attributes:

Educational researchers generally agree that research should be rigorous and systematic. However, there is less agreement about specific standards, criteria and research procedures. Educational researchers may draw upon a variety of disciplines. These disciplines include psychology, sociology, anthropology, education and philosophy.

Methods may be drawn from a range of disciplines. Conclusions drawn from an individual research study may be limited by the characteristics of the participants who were studied and the conditions under which the study was conducted (https://en.wikipedia.org/wiki/Educational_research).

Gary Anderson outlined ten aspects of educational research:

- Educational research attempts to solve a 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.
- 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 basis for educational research is the scientific method. The scientific method uses directed questions and manipulation of variables to systematically find information about the teaching and learning process. In this scenario questions are answered by the analysis of data that is collected specifically for the purpose of answering these questions. Hypotheses are written and subsequently proved or disproved by data which leads to the creation of new hypotheses. The two main types of data that are used under this method are qualitative and quantitative.

There also exists a new school of thought that these derivatives of the scientific method are far too reductionist in nature. Since educational research includes other disciplines such as psychology, sociology, anthropology, science, and philosophy and refers to work done in a wide variety of contexts it is proposed that researchers

should use “multiple research approaches and theoretical constructs”. This could mean using a combination of qualitative and quantitative methods as well as common methodology from the fields mentioned above. In social research this phenomenon is referred to as triangulation (social science).

This idea is well summarized by the work of Barrow in his text ‘An introduction to philosophy of education’: ‘Since educational issues are of many different kinds and logical types, it is to be expected that quite different types of research should be brought into play on different occasions. The question therefore is not whether research into teaching should be conducted by means of quantitative measures (on some such grounds as that they are more ‘objective’) or qualitative measures (on some such grounds as that they are more ‘insightful’), but what kind of research can sensibly be utilized to look into this particular aspect of teaching as opposed to that’. Moreover, special education being an integral area or subset of education, the subsequent section will deal with the needs of Special Education research in particular.

1.6.3 Outcome:

Research in special education has yielded beneficial outcomes for students with disabilities as well as typical achieving students. There are valuable knowledge special education research has generated, including the essentials of response to intervention (e.g., screening, progress and monitoring), instructional practices such as systematic instruction and feedback, and intensive interventions designed to meet the specific learning needs of students with disabilities. There should be appropriate funding brook for quality research in special education to improve outcomes for students with disabilities as well as typical learners (Swanson & Vaughn, 2015)

The inclusive classroom relies on the simultaneous use of differentiated instruction and assessment techniques for maximizing a student’s learning potential by tailoring the teaching to every student. Although many educational innovations take shape and undergo testing in the classroom, research is necessary to substantiate these new techniques beyond anecdotal evidence. This helps broaden their exposure, boosts their inclusion in professional development programs for teachers, and encourages widespread implementation.

In order to maintain the development of special education innovations, teachers/ students will have the opportunity to do their own research and gain valuable practical experience by applying their findings within the classroom in real time.

In “No Child Left Behind: A Desktop Reference,” the Office of the Under Secretary to the Department of Education wrote that “The NCLB Act puts a special emphasis on determining what educational programs and practices have been clearly demonstrated to be effective through rigorous scientific research.” Moreover, the NCLB allotted extensive funding to traditionally disadvantaged school systems to help them implement these proven methods of improved instruction, curriculum design, and systemic educational development.

Research can now substantiate the many teaching methods educators use. This validation has helped many innovations in instructional strategy and classroom design gain grip and enjoy extensive accomplishment. It has helped broaden their scope significantly more than teacher collaboration and sharing alone. Researches in education and special education has dared the challenge of closing the achievement gap, many of the innovations and much of the progress in teaching methodology have emerged that are successfully executed in special education or inclusive classroom.

The strictures of special education have always mandated the teaching of students based on the unique learning needs and goals of each. Yet, when included in a classroom with generalized instruction and uniform assessment, differently able students are at a disadvantage. In “Differentiated instruction: A research basis,” author Pearl Subban describes differentiation as “a philosophy of teaching that is based on the premise that students learn well when their teachers accommodate the differences in their readiness levels, interests and learning profiles.”

Assimilating a multitude of findings from various research papers, Subban could quantitatively substantiate many positive effects of differentiation research in the inclusive classroom. These improvements are clear in both academic achievement as well as the social/emotional development of students. Moreover, students with cognitive, emotional and physical disabilities showed the highest levels of improvement from inclusion in the differentiated classroom. Researches in these areas have lighted the runway for implementation and success of Inclusive Education.

Similar findings emerged on reading education that the Institute of Education conducted over eight years. Students with various special needs, whether cognitive or physical, benefited substantially from early intervention, assessment of ideal learning styles, and the application of appropriate differentiated instructional techniques to reading education.

Research into effective teaching methodology has clear implications for the improvement of special education programs. This is especially true in today’s

increasingly diverse, inclusive classrooms. For research to have the most impact, school systems should emphasize extensive professional development in proven teaching methods.

Special education teachers who understand research methodology and supported practices can not only innovate in the classroom but also help other teachers understand and incorporate new and effective teaching strategies, helping all students achieve their highest potential.(https://online.uwsuper.edu/articles/research-in-special-education.aspx)

Certainly, in their research, educational psychologists should shun approaches that fail to incorporate meaningful ways of interacting with young people, for the barebones of statistical evidence are made far more comprehensible by the flesh of qualitative accounts of daily life Learning in social science must have a sensory base; tables of data must have some connection with people who can be seen or heard in action.

Similarly, Phares and Lamiell (1977) lament the lack of sustained contact between many psychology researchers and their research participants:… Somehow we have to get back to research that involves something other than fleeting contacts with subjects, deductions from super-ANOVA tables to the exclusion of experience with people, and the unrealities of the laboratory that may engage hierarchies of needs and cognitions wholly different from what we are trying to capture.

Research findings will also have an important socio-historical component that can be overlaid, even transformed by the effects of economic and social upheaval. The latest ongoing cross-cultural study of achievement motivation examines influences and practices at school, at home, in the local community, and nationally. Its methods include the use of surveys; individual interviews repeated over time; videos of classrooms; focus groups; diaries in which students record their actions, thoughts, and feelings Such investigations, however, are often time-consuming, messy, expensive, and difficult to establish—particularly when working cross culturally.

Furthermore, they result in studies that may appear to lack theprecision, objectivity, and rigour of traditional research approaches in educationalpsychology. As a result, articles coverage findings from such work mayfind it harder to gain acceptance for publication in those journals that carry thegreatest prestige within the academic community. In a country like India, special education research has to be uplifted by government recognition. The government agencies or the funding agencies have to come within reach for a fluent drive on researches in the areas of special

education, disability studies, rehabilitation etc. However,this, in itself, should not provide justification for researchers to dispense withcomplexity, for, like life itself, education is also a messy and complex businessthat is not easily studied or understood. Our business, as education researchers,is ultimately to shed light upon the complexities of educational practice andunderstanding in order that learning in research may be enhanced.

Mixed methods research combines theoretical and/or technical aspects of quantitative and

Qualitative research in a particular study. We draw positive implications for organizational systems field for clearlywriting about mixed research methods in publications.

Few examples exist in the fields of human resourcedevelopment, distance education, and foreign Language education, of intentionally using theinquiry literature on mixing qualitative and Quantitative methods in one research project.Mixed methods research is characterized asresearch that contains elements of both qualitativeand quantitative approaches (Brewer & Hunter,1989; Howe, 1988; Miles & Huberman, 1984;Patton, 1990). There is no typical model in the education of disabled children, because any proposition is first defined by a team, in an attempt to understand the child's needs, the family's availability, and the assistance service functioning. In conclusion, disability can always be compensated by the child's capacities within his psychophysical potential.

1.7: Ethics in research:

1.7.1 Prelude

Axiology refers to the ethical issues that need to be considered when planning a research proposal. It considers the philosophical approach to making decisions of value or the right decisions (Finnis, 1980). It involves defining, evaluating and understanding concepts of right and wrong behaviour relating to the research. It considers what value we shall attribute to the different aspects of our research, the participants, the data and the audience to which we shall report the results of our research. Put simply, it addresses the question: What is the nature of ethics or ethical behaviour? In answer to this question, it is important to consider your regard for human values of everyone that will be involved with or participate in your research project. This consideration is facilitated by the following questions.

What values will you live by or be guided by as you conduct your research? What ought to be done to respect all participants' rights? What are the moral issues and characteristics that need to be considered? Which cultural, intercultural and moral issues arise and how will I address them? How shall I secure the goodwill of participants? How shall I conduct the research in a socially just, respectful and peaceful manner? How shall I avoid or minimise risk or harm, whether it be physical, psychological, legal, social, economic or other? (ARC,2015). Answers to these questions are best guided by four criteria of ethical conduct namely, teleology, deontology, morality and fairness (Mill, 1969). Technically, teleology is the theory of morality which postulates that doing what is intrinsically good or desirable, is a moral obligation that should be pursued in every human endeavour. And so, teleology refers to attempts made in research to make sure that the research results in a meaningful outcome that will satisfy as many people as possible. An application of this criterion is facilitated by questions such as, are the methods used in this research pragmatic and do they make common sense? Will the actions undertaken in the research produce more benefits than harm? Am I convinced that the actions that will be taken during the research will be the right ones? Have I considered all possible consequences of this research? Deontology is the understanding that every action that will be undertaken during the research will have its own consequence, intended to benefit participants, the researcher, the scholastic community or the public at large (Scheffler, 1982). It also allows for flexibility to deal with individual participants or observations. The morality criterion refers to the intrinsic moral values that will be upheld during the research. For example, that the researcher will be truthful in their interpretation of the data. Finally, the criterion of fairness draws the researcher's attention to the need to be fair to all research participants and to ensure that their rights are upheld. Implementation of this criterion is guided by questions such as, how fair will my research actions be? Will they treat all research participants in the same way? Will my actions show favouritism and/or discrimination towards any participants? And so in the section on ethical considerations for your higher degree research proposal, you should demonstrate best ethical conduct by showing an understanding of what is right or wrong behaviour as you conduct the research. This consideration is founded on the understanding that all humans have dignity which must be respected, and they have a fundamental human right to make choices which you as a researcher must respect. Implementation of ethical considerations focuses on four principles which you need to uphold when dealing with your participants and data. These principles have the acronym PAPA namely: Privacy, Accuracy, Property, and Accessibility, following Sidgwick, (1907) and Slote, (1985).

1.7.2 Principles

The five main principles of ethics are usually considered to be: (https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=225&printable=1):

- Truthfulness and confidentiality
- Autonomy and informed consent
- Beneficence
- Non-maleficence
- Justice.

1.7.3 Research ethics:

An outline of related studies enclave numerous virtues that provides guidelines for the responsible conduct of research. In addition, it educates and monitors academicians/ researchers conducting research to ensure a high ethical standard. The following is a general summary of some ethical principles:

1. **Honesty:**Honestly report data, results, methods and procedures, and publication status. Do not fabricate, falsify, or misrepresent data.
2. **Objectivity:**Strive to avoid bias in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research.
3. **Integrity:** Keep your promises and agreements; act with sincerity; strive for consistency of thought and action.
4. **Carefulness:** Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities.
5. **Openness:** Share data, results, ideas, tools, resources. Be open to criticism and new ideas.
6. **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. Never plagiarize.
7. **Confidentiality:** Protect confidential communications, such as papers or grants submitted for publication, personnel records, trade or military secrets, and patient records.

8. **Responsible Publication:** Publish in order to advance research and scholarship, not to advance just your own career. Avoid wasteful and duplicative publication.
9. **Responsible Mentoring:** Help to educate, mentor, and advise students. Promote their welfare and allow them to make their own decisions.
10. **Respect for Colleagues:** Respect your colleagues and treat them fairly.
11. **Social Responsibility:** Strive to promote social good and prevent or mitigate social harms through research, public education, and advocacy.
12. **Non-Discrimination:** Avoid discrimination against colleagues or students on the basis of sex, race, ethnicity, or other factors that are not related to their scientific competence and integrity.
13. **Competence:** Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.
14. **Legality:** Know and obey relevant laws and institutional and governmental policies.
15. **Human Subjects Protection:** When conducting research on human subjects, minimize harms and risks and maximize benefits; respect human dignity, privacy, and autonomy.

(https://libguides.library.cityu.edu.hk/researchmethods/ethics)

1.7.4 Research Misconducts:

Apart from the plausible ethical issues discussed above, there are certain misconducts plaguing research works and other academic pursuit. They are:

(a) Fabrication - making up data or results and recording or reporting them.

(b Falsification - manipulating research materials, or changing or omitting data or results such that the research is not accurately represented in the research record.

(c) Plagiarism - the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.

N.B: Research misconduct does not include honest error or differences of opinion.

(Source: Definition of Research Misconduct. The Office of Research Integrity, U.S. Department of Health & Human Services)

There are many other activities that the government does not define as "misconduct" but which are still regarded by most researchers as unethical. These are sometimes referred to as "other deviations" from acceptable research practices and include (Resnik, 2015):

1. Publishing the same paper in two different journals without telling the editors
2. Submitting the same paper to different journals without telling the editors
3. Not informing a collaborator of your intent to file a patent in order to make sure that you are the sole inventor
4. Including a colleague as an author on a paper in return for a favor even though the colleague did not make a serious contribution to the paper
5. Discussing with your colleagues confidential data from a paper that you are reviewing for a journal
6. Using data, ideas, or methods you learn about while reviewing a grant or a papers without permission
7. Trimming outliers from a data set without discussing your reasons in paper
8. Using an inappropriate statistical technique in order to enhance the significance of your research
9. Bypassing the peer review process and announcing your results through a press conference without giving peers adequate information to review your work
10. Conducting a review of the literature that fails to acknowledge the contributions of other people in the field or relevant prior work
11. Stretching the truth on a grant application in order to convince reviewers that your project will make a significant contribution to the field
12. Stretching the truth on a job application or curriculum vita
13. Giving the same research project to two graduate students in order to see who can do it the fastest
14. Overworking, neglecting, or exploiting graduate or post-doctoral students
15. Failing to keep good research records
16. Failing to maintain research data for a reasonable period of time

17. Making derogatory comments and personal attacks in your review of author's submission
18. Promising a student a better grade for sexual favors
19. Using a racist epithet in the laboratory
20. Making significant deviations from the research protocol approved by your institution's Animal Care and Use Committee or Institutional Review Board for Human Subjects Research without telling the committee or the board
21. Not reporting an adverse event in a human research experiment
22. Wasting animals in research
23. Exposing students and staff to biological risks in violation of your institution's biosafety rules
24. Sabotaging someone's work
25. Stealing supplies, books, or data
26. Rigging an experiment so you know how it will turn out
27. Making unauthorized copies of data, papers, or computer program

1.7.5 Privacy

Under this principle, you need to consider what information participants will be required to reveal to you or to others about themselves, their associations or organisations? It considers the conditions and safeguards under which data will be gathered and analysed. What things, for example, can participants keep to themselves, and not be forced to reveal to you or any other people.

1.8: Let us Sum up:

Research Methodology is the broad term used to refer to the research design, methods, approaches and procedures used in an investigation that is well planned to find out something (Keeves, 1997). For example, data gathering, participants, instruments used, and data analysis, are all parts of the broad field of methodology. In sum, the methodology articulates the logic and flow of the systematic processes followed in conducting a research project, so as to gain knowledge about a research problem. It includes assumptions made, limitations encountered and how they were mitigated or minimised. It focuses on how we come to know the world or gain knowledge about part of it (Moreno, 1947). The following

summary would help you to understand the basic characteristics of theories in research that is normally located within the Positivist paradigm (Neurath, 1973 & Fadhel, 2002). Wondrously quoted under, the following verses on RESEARCH:

Research is like a plantthat grows and growsand grows and grows...

When it is grownit throws off seeds of all types(basic, applied, and practical),which in turn sprout andcreate more research projects.

The process continues withall of the new research 'plants'throwing off seeds, creatingadditional, related research projectsof various types.

Soon there is a body of basic, applied, and practical

research projects related to similar topics.

And the process goes on and on...

Source: http://linguistics.byu.edu/faculty/henrichsenl/ResearchMethods/RM_1_02.html

Educational research with its characteristics is influenced by many paradigms. Each paradigm has its own epistemology, ontology, and quality standards which influence the researchers to find the truth and see the reality. The important point is that knowing the nature of each paradigm which can help the researchers to conduct their research process. Researchers can conduct the research within and across paradigms which is called multi-paradigmatic research paradigms (Taylor, 2008).

The nature of educational research is analogous with the nature of research itself, which is systematic, reliable and valid to find the "truth", investigates knowledge, and solves problems. Moreover, educational research process involves steps to collect the information in order to investigate problems and knowledge. However, the educational research is more complex because it can use various approaches and strategies to solve problems in educational setting. It also can involve many disciplines such as anthropology, sociology, behaviour, and history. In addition, educational research is important because of contributing knowledge development, practical improvement, and policy information. Therefore, educators can use those research findings to improve their competences and teaching and learning process (Yulirahmawati, 2008).

(Retrieved from: Essays, UK. (November 2018). The Role And Importance Of Educational Research Philosophy Essay. Retrieved from https://www.ukessays.com/essays/philosophy/the-role-and-importance-of-educational-research-philosophy-essay.php?vref=1)

1.9: Unit End exercises:

1. Why do we do research in Education?
2. Delineate the four basic sources of Knowledge.
3. Illustrate Sociology of knowledge as propounded by Plato.
4. Explain superstition and Pseudoscience.
5. Define scientific research.
6. Establish a relationship between Science and Research.
7. What is meant by theory, hypothesis and models?
8. List the components of Theory.
9. Give an outline of few aspects of Educational research?
10. Mention the principles of ethics in an academe.

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Unit – 2 □ Types and Methods of Research

Structure

2.1. Introduction

Welcome to the arena of Educational Research. But before going into the Unit, first ask yourself what is Research? And think about that. In the quest for knowledge, which marks this civilization, research has become an essential part of human activity. Research is a search or investigation directed to the discovery of some fact by careful consideration or study of a subject; a course of critical or scientific enquiry. In this Unit, we will discuss the different types of research like – Quantitative, Qualitative, Fundamental, Applied, Action etc. Then we will try to understand the basic concepts of about the various methods of Research like- Descriptive, Co-relational, Ex-post facto and Experimental. Research is a scientific process begins with a specific problem and end with a specific finding. Entire process of research will be discussed in this unit. We hope you will enjoy this Block and it will motivate you to think in new ways.

2.2 Objectives

After completing the course, teacher educators will be able to…

- discuss the different types of research.
- explain different types of research methods.
- analyse critically the variables of research.
- elucidate the process of research
- describe the process of standardization of research instrument.

2.3 Types of Research

There are various bases to classify the research.

A. On the Basis of Objectives of Research

On the basis of objectives of research they are of two types:

1. Fundamental research

2. Applied research and

2. Action research.

B. On the Basis of Approach of Research

On the basis of approach of Research they are of two types:

Longitudinal research: Historical research, case study, genetic comes underlongitudinal approach of research.

Cross sectional research: Experimental research, survey are the examples ofcross sectional research.

C. On the Basis of Precision in Research Findings

On the basis of precision (accuracy) the researches are:

1. Experimental research and

2. Non-experimental research.

Experimental research is precise while non-experimental is not.

D. On the Basis of Nature of Findings

On the basis of findings Researches are of two types:

Explanatory research: Such researches explain more concerned theories. Lawsand principles.

Descriptive research: These are more concerned with facts.

F. Another Classification

Adhoc research: Adhoc research is the class of inquiry used for a purpose aloneand special.

Empirical research: Empirical research is that which depends upon theexperience or observation of phenomena and events.

Explained research: Explained research is that which is based on a theory.

Boarder line research: Boarder line research is that which involves those main two branches or areas of science. For example study of public school finance.

2.3.1 Quantitative Research

Quantitative research is about collecting and analyzing data to explain phenomena. Information from a sample is used to make generalizations or predictions about

a population. Some questions that are easily answered using information from samples include:

- What percentage of high school teachers belong to minority groups?
- How many females in college study mathematics compared to males?
- Has the high school graduation rate in our district increased over time?

However, data doesn't always naturally happen in a numerical way. You may want to answer questions like:

- What do high school students think of their teachers?
- What is the general public opinion of health care reform?
- What do customers at a particular business think of customer service?

These questions aren't immediately quantifiable, but you can turn them into quantifiable questions by assigning numbers to them. For example, you could make a survey with the following question and responses:

"I think that customer service at this business is excellent."

- Strongly Agree.
- Agree.
- No opinion.
- Disagree.
- Strongly disagree.

Elements of Quantitative Research Methods:

The crucial elements of quantitative research design are:

Quantitative research designs are either descriptive or experimental. Descriptive designs are where you measure an association between two variables (independent and dependent variables). Sample sizes are typically large. For example, you might survey thousands of local students. Subjects are usually only measured once. In an experimental design, subjects are usually measured both before and after a treatment and you're looking for causality. Sample sizes tend to be small. For example, you might be analyzing a treatment for a small number of cancer patients.

Advantages of Quantitative Research

The use of statistical analysis and hard numbers found in quantitative research has distinct advantages in the research process.

1. **Can be tested and checked.** Quantitative research requires careful experimental design and the ability for anyone to replicate both the test and the results. This makes the data you gather more reliable and less open to argument.
2. **Straightforward analysis.** When you collect quantitative data, the type of results will tell you which statistical tests are appropriate to use. As a result, interpreting your data and presenting those findings is straightforward and less open to error and subjectivity.
3. **Prestige.** Research that involves complex statistics and data analysis is considered valuable and impressive because many people don't understand the mathematics involved. Quantitative research is associated with technical advancements like computer modeling, stock selection, portfolio evaluation, and other data-based business decisions. The association of prestige and value with quantitative research can reflect well on your small business.

Disadvantages of Quantitative Research

However, the focus on numbers found in quantitative research can also be limiting, leading to several disadvantages.

1. **False focus on numbers.** Quantitative research can be limited in its pursuit of concrete, statistical relationships, which can lead to researchers overlooking broader themes and relationships. By focusing solely on numbers, you run the risk of missing surprising or big-picture information that can benefit your business.
2. **Difficulty setting up a research model.** When you conduct quantitative research, you need to carefully develop a hypothesis and set up a model for collecting and analyzing data. Any errors in your set up, bias on the part of the researcher, or mistakes in execution can invalidate all your results. Even coming up with a hypothesis can be subjective, especially if you have a specific question that you already know you want to prove or disprove.
3. **Can be misleading.** Many people assume that because quantitative research is based on statistics it is more credible or scientific than observational, qualitative research. However, both kinds of research can be subjective and misleading. The opinions and biases of a researcher are just as likely to impact quantitative approaches to information gathering. In fact, the impact of this bias occurs earlier in the process of quantitative research than it does in qualitative research.

2.3.2 Qualitative Research:

Qualitative research (QR) is way to gain a deeper understanding of an event, organization or culture. Depending on what type of phenomenon you are studying, QR can give you a broad understanding of events, data about human groups, and broad patterns behind events and people. While traditional lab-based research looks for a specific "something" in the testing environment, qualitative research allows the meaning, themes, or data to emerge from the study.

Qualitative research uses non-statistical methods to gain understanding about a population. In other words, you're not dealing with the numbers you'd find in quantitative research. For example, let's say your research project was to answer the question "Why do people buy fast food?". Instead of a survey (which can usually be analyzed with math), you might use in-depth interviews to gain a deeper understanding of people's motives. Another major difference between qualitative and quantitative research is that QR is usually performed in a natural setting (As opposed to a lab).

Characteristics of Qualitative Research:

All of the different qualitative research methods have several characteristics (Merriam):

- Findings are judged by whether they make sense and are consistent with the collected data.
- Results are validated externally by how well they might be applicable to other situations. This is tough to do; rich, detailed descriptions can help to bolster external validity.
- Data is usually collected from small, specific and non-random samples.
- Although qualitative research doesn't have the same structure as a formal lab-testing environment, there are certain requirements you must meet in order for your qualitative study to be called "research." Your study must:
- Have a formulated research purpose. For example "…examine the lifestyles of Chinese immigrants."
- Be related to existing theories, published or unpublished. You can't just make up an idea that has no basic in current thinking. For example, a study to see how immigrants cope in the workplace would build on previous, similar studies. However, there would be no previous theories for something out-of-left field like "Why do Italian immigrants prefer Pepsi?"
- Be well-planned. You can't go into the jungle with no plan and no idea of how you're going accomplish your goals.

- Be recorded carefully with notes and other media like film or voice recordings. If you don't take careful notes, you could miss something of vital importance.
- Other rules you must follow include selecting the people or events you want to observe, having a plan on how you're going to get into the "world" you want to observe, and deciding ahead of time what types of data you're going to gather.

Types of Qualitative Research Methods:

Anthropological:

Anthropological researchers study people in their natural environment, sometimes immersing themselves in foreign cultures for years. The focus is on meaning, transmitted through language and action. For example, a raised finger might mean something trivial in one society while in another it's a gross insult. This type of research is invaluable when it would be inappropriate or impossible to put people in a laboratory setting or even conduct a simple interview. For example, members of a street gang would likely refuse interviews, and it's both highly expensive and inappropriate to place people from non-Western cultures (i.e. pygmies) in a lab.

Auto ethnography:

In this research method, you use your own experiences to address a cultural, political, or social issue. It is considered by many to be a non-traditional ethnographic method. This type of research can involve several people. For example, a group of immigrant women researchers conducted a study on how they navigated the US academy as immigrant women faculty (Ngunjiri et. al 2010).

Critical Social Research:

Critical social research studies specific oppressive social structures (Harvey, 1990). This type of research attempts to expose problems, evaluate the problems and find their root causes. For example, critical social research could attempt to uncover cases of juvenile crime, racism, or suicide.

Ethical Inquiry:

Ethical inquiry is a research method used in philosophy to answer ethical questions such as Is it ethical to eat animals? or The Ethics of HIV Criminalization.

Ethnographic Research:

Ethnography is the study of people in their own environment through methods like participant observation and face-to-face interviewing. The difference between

anthropological and ethnographic research is small, but significant. While anthropological research involves all of the cultures on the planet, classic ethnographic research provides a detailed description of an entire culture outside of the country of origin of the researcher (Ingold, 2008).

Field Research:

Field research is research outside of a lab, in a natural setting. This type of research usually involves first hand note-taking. It may also include video footage, interviews with experts in the area being studied, conducting surveys or attending public discussion forums.

Grounded Theory Research:

Grounded theory is often categorized as a qualitative research method, but technically it can be applied to either quantitative research or qualitative research; it's a general research method involving a set of rigorous procedures. The result is (hopefully) a set of conceptual data categories. The "Theory" in grounded theory refers to the theory of what you are studying. For example, you might have a theory about the eating habits of the Nez Perce Tribe. The "Grounded" part refers to the fact that your theory needs to be grounded in research. That's the simple definition. In reality, it's a type of QR that's poorly understood, with many researchers claiming they used it, when in fact they did not. It's actually a fairly complicated process that builds upon itself. You start by generating questions to guide your research. These questions identify core concepts, which lead you to identifying links between your questions and your data. This part of the process can take months. For a detailed outline of the grounded theory process, see Odis Simmon's outline here.

Naturalistic:

Naturalistic research is research that doesn't manipulate anything in the environment. In other words, it's the opposite of a lab environment where variables are manipulated on purpose. Care should be taken with naturalistic research, as even your presence can alter the environment–taking away the "naturalistic" component. Bias can easily creep in to these types of studies; two people can have different viewpoints of the same thing. It's a common safeguard to have two or more researchers observing the same thing so that any differences in viewpoint can be addressed.

Participant Observer Research:

In this type of research, you participate in the activity and record observations. It differs from naturalistic research because you actually participate in the activity you are

researching. For example, you might become a member of a cult, enroll in spelunking courses, or go undercover as a dishwasher at a restaurant. Although this is a great way to get an insider viewpoint, it carries risks. For example, bias and reactivity are magnified in participant observer research. Bias seeps in because you are looking through one lens (yours). As hard as you try to make sure your notes are accurate, you might have biases that you aren't aware of. Reactivity is where your actions change what is happening. As you are more than just an observer, it's difficult not to have some influence in what's going on around you. A fairly famous example of this type of research was undertaken by Leon Festinger, Henry Riecken and Stanley Schachter, who infiltrated a UFO religion called The Seekers.

Phenomenology:

Phenomenology studies someone's perception of an event. The focus of this type of study is what people's experiences are for a particular event and how they interpret their experiences. For example: a study of Hurricane Katrina survivor's perceptions, understandings, and perspectives of the hurricane.

Advantages and Disadvantages of Qualitative Research Methods:

Qualitative research is not part of statistical analysis. That's because the results can't be tested to see if they are statistically significant (i.e. to see if the results could have occurred by chance). As a result, findings can't be extended to a wider population. That doesn't mean this type of research is useless: in many studies, getting hard numbers is inappropriate or just impossible.

Advantages:

If qualitative research can't be used to estimate statistics for a population, why use it at all? One reason is that while statistics concentrates on specific, narrow areas (for example, population means, medians or standard deviations), qualitative analysis paints a wider, complete picture. In addition, a phenomenon that's rare receives the same level of attention as more common phenomena. Other advantages include:

- It's useful for finding out more about complex situations.
- Allows the use of an "insider viewpoint.
- Data is based on the participant's views of the world, rather than a world created by a researcher.
- Can be used to figure out how people interpret constructs like IQ or fear, which can be hard to quantify.

- The study focus can be shifted in the middle of research, if necessary. In a traditional lab setting, this would usually null-and-void the experiment.
- An important case can be used to vividly paint a picture in a report.

Disadvantages:

One of the main disadvantages to qualitative research is that your data usually can't be generalized outside of your research. For example, if you find that an Asian street gang has a certain hierarchy, then that hierarchy likely exists only within Asian street gangs, and perhaps only in the particular gang you studied.

- Predictions of future events are usually impossible to quantify (i.e. you wouldn't be able to say "there is a 95% chance of this event happening in the future.").
- Qualitative research, in general, has lower credibility than quantitative research. This may make it more difficult to get your results published.
- Data collection takes a lot longer than in a traditional lab setting.
- Your own personal biases and other idiosyncrasies are more likely to affect the research.

Traditionally on the basis of immediate purpose research is of three types:

- ❖ Basic Research
- ❖ Applied Research
- ❖ Action Research

2.3.3 Basic Research/ Fundamental Research:

This is also known as pure, fundamental or even theoretical research. It is research for knowledge sake; aim is new knowledge irrespective of any use at the moment of discovery. There may not be any immediate need or application of the new knowledge thus produced; nor it is conducted for any immediate gain or problem solving. It may be done out of curiosity, or to build a theory. Greatest research experiments and expeditions fall in this category of research. Why the man went to moon? In our field the five laws of library science by S. R. Ranganathan were formulated as a theoretical research. It is mostly conducted in academic and related research centers.

2.3.4 Applied Research:

Research conducted to solve any immediate problem of theory or practice at hand is known as applied research. It is of practical nature. Example are "Action research"

"Case Studies", "Clinical Research", "Research and Development", popularly known as R&D. Most of the research in industry, business, military and government departments is of applied or practical nature. For example,

- To design a system to record the receipt of periodicals and to automatically send reminders when due for more than a month.
- To diagnose the very low use of a certain collection in a library.
- To find solution to the decreasing space problems in libraries in 1960s. Library and information management is a fertile field for applied research.

2.3.5 Action Research:

Action Research Developed in 1930s in education, action research is a form of interpretive research to study human actions and social practices with the participation of the researcher. It is an applied research, which is focused on immediate application, not to develop any theory for general applications. Emphasis is on a local problem, which involves the researcher and takes the librarian to jointly seek and find a solution to a library problem. For example, the problem could be as simple as "How to improve upon the existing circulation of periodicals among the research scientists in the research institution." Its purpose for our field may be to improve library management and use; and ultimately to improve the skill of the librarian i.e. to change the ways to do things more effectively. It requires identification of practices that need change to meet the needs of the changing use pattern of libraries or meeting new demands of users and to take better decisions. Simply speaking it is common sense and good management, and not any genuine research. It is applied research whose aim is to provide practical benefits to the client. The researcher is expected to do so methodologically, it is cyclic research to solve problems and generate new knowledge simultaneously. Majola J.H. Oosthaizen gives the following equation and diagram to show its nature: Action research = Action + Research (knowledge generated). It is to bring out progressive and incremental improvement in practice as it goes through different cycle after cycle.

Characteristics of Action Research:

- Action research is usually focused on a single situation, say on a single library:
- It is carried out in a series of cycles one improving upon the previous.
- It is mostly reflective and audit like or evaluative.
- It is concerned with real practice to examine if the practice needs change.
- In each cycle a hypothesis is proposed, tested and next action is planned.

- Method is refined in each cycle by using different method of observation and interpretation.
- It involves many people such as informants, interpreters, planners, administrators and researchers – the list is not exhaustive.

Therefore, it also requires communication skills and conflict management. Each cycle may use a different method. In such case the action research may take the following form:

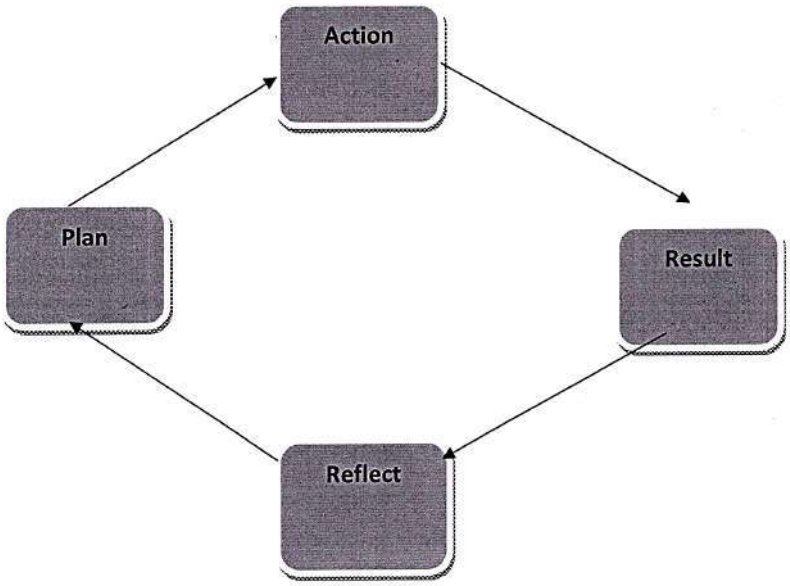


Fig: Cycle of Action Research

Steps of Action Research:

The research work is done by reflective thinking and not by traditional thinking. The reflective thinking functions systematically. The steps of research are drawn from reflective thinking.

The following are the six steps of research:

1. Selection of the problem.

2. Formulation of hypotheses.

3. Design of research.

4. Collection of data.

5. Analysis of data.

6. Formulation of conclusions.

First Step

The problem is selected and defined. The feasibility of the problem depends on its delimitations. Hence, the problem is also delimited in this step.

Second Step

Some tentative solutions are given for the problem when these solutions are based on certain rationale they are termed as hypothesis. Therefore, in this step hypotheses are formulated.

Third Step

These hypotheses are subjected to verification. A design of research is developed for collection of data or evidences for testing the hypotheses. It involves method, sample and techniques of research. The appropriate method and techniques are selected for this purpose.

Fourth Step

The observations and research tools are administered on the subjects and their responses are scored out. Thus, the obtained data are organized in tabular form.

Fifth Step

The appropriate statistical techniques are used to analyse the data so that some decisions maybe taken about the hypotheses. The results are used to draw some conclusions.

Sixth Step

The results are discussed and some conclusions are drawn in the form of new information, theory, facts and solution for the practical problems.

These steps are followed in both types of research: fundamental and action research, but there is significant difference between the two. The comparison of fundamental and action research has been provided in the tabular form on next pages.

Objectives of Action Research:

The action research projects are conducted for achieving the following objectives:

1. To improve the working conditions of school plant.
2. To develop the scientific attitude among teachers and principals for studying their problems.
3. To develop the scientific attitude among students and teachers for understanding and solving their problems.
4. To bring excellence in school workers.
5. To develop the ability and understanding among administrators to improve and modify the school conditions and make it more conducive to learning.
6. To root out the traditional and mechanical environment of school.
7. To make the school system effective for generating a healthy environment forstudent learning.
8. To raise the level of performance and level of aspiration of the students.

2.4 Method of Research

2.4.1 Descriptive Method

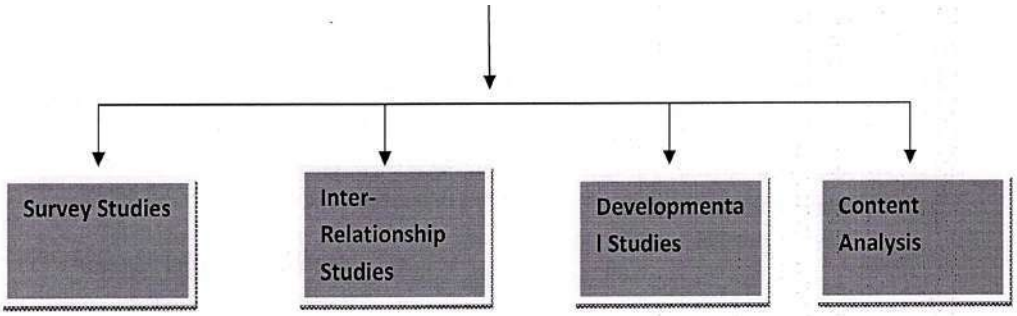
The term survey is used for the techniques of investigation by a direct observation of a phenomenon or a systematic gathering of data from population by applying personal contact and interviews when adequate information about certain problem is not available in records, files and other sources.

The survey is an important tool to gather evidences relating to certain social problems. The term social survey indicates the study of social phenomena through a survey of a small sampled population and also to broad segments of population. It is concerned with the present and attempts to determine the status of the phenomenon under investigation.

Types of Descriptive Method:

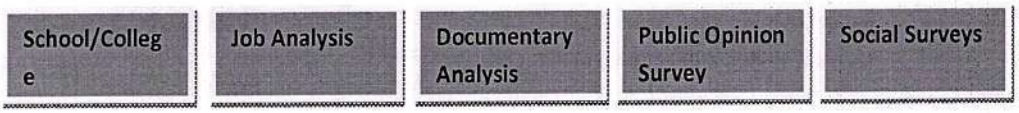
Descriptive method is divided into four parts. They are;

Descriptive method

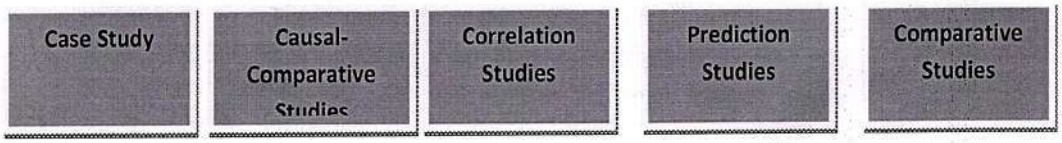


The Survey Studies:

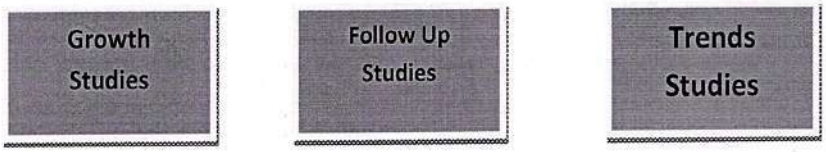
They are of following types;



The Inter-relationship Studies are of following types;



The Developmental Studies are of the following types;



2.4.2 Co-relational Method:

Introduction:

Research in education and psychology can be roughly divided into quantitative research, qualitative research, and historical research. Quantitative research methods can be categorised as descriptive research, co-relational research, and experimental research.

As with any survey, other descriptive methods are often used in education in the study of correlation. This study has examined the relationship of two or more variables, namely the extent to which variation in one variable is associated with variations in other variables. The degree of relationship variables declared in a single index is called correlation coefficient. The correlation coefficient can be used to test hypotheses about the relationship between variables or to declare a large-small relationship between two variables.

Purpose of Co-relational Studies:

The purpose of these studies also, like the casual-comparative studies, is to find out relationship between variables. But, while the other methods tell only about the fact of relationship, the relationship exists or not, co-relational studies go a step further and tell how much the relationship is.

Design of Co-relational Research

According to Mc Milan and Achumaker (2003) the stages cover problem determination, problem review or literary study, hypothesis, research design and research methodology, data collecting, data analysing and conclusion.

1. Problem Determination

In co-relational research, the chosen problem must have a valuable point in complex phenomenon attitude that needs an understanding. Despite it, the variable involved in the research must consider certain things like theoretically, logically, and that the variable has certain relation. This may be obtained by the previous research.

2. Problem Review

After determining the problem, the important thing to do in research is problem review. The researcher may obtain the problem review from various sources like journal, reports, result of a research, science magazine, newspaper, relevant books, articles, the conclusion of seminars or other sources.

3. Research Design:

The researcher determines the subject of the research and determines how to calculate the data. The subject involved in the research must be measured in variables that become the research focus. The object should be homogeneous in external factors of variable that is investigated that may influence dependent variable.

4. Data collecting:

Various instruments are used to measure and collect data in each variable, in example questionnaire, test, interview guidance, and observation guidance as they're needed. The data collected by those instruments must be in numbers. In co-relational research, variable measuring is doing in the same time whereas in predictive research, predictor variable has to be measured a while before the criteria variable emerges to produce a meaningful criteria prediction.

5. Data Analysis:

Basically, the analysis in co-relational research is done by correlating the result of one variable measurement with another result of variable measurement. In co-relational research, bivariate correlation technique based on its data is used to calculate the level of relation among variables. Whereas in predictive, the technique used is regression analysis to determine the level of predictive ability of predictor variable to criteria variable. If there are only two variables a regular correlation analysis is used, if there are more than two variables multiple regressions or canonical analysis is used. The result of the analysis is usually reported in coefficient correlation value or regression coefficient as well for the significance level and the variant proportion of independent variable to dependent variable.

The data interpretation in co-relational research is when two variables are correlated and resulted coefficient correlation with the (r) symbol. That variable relation valued in -1 until +1. The value of(-) shows a negative correlation in variables that is contradictory with each other and the value of (+)show a positive correlation in variables that is approaching the same direction .

Characteristic of Co-relational Research:

1. The research is suitable if the variables are complicated or cannot be researched by experimental method or cannot be manipulated.

2. The research enables to measure some variables and the relations in advances for its real condition.

3. The output of the research is a level or the high and low of relation and not the presence or absence of that relation.

4. The research may predict certain variables based on independent variable.

2.4.3 Ex-Post Facto Research Method:

Concept and Meaning of Ex-Post Facto Research:

The 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 in order 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 behavior. The expected possibilities may be lack of discipline at school/ family history/ peer effect/ neighborhood or socialization. It is an interesting point to note that, the researcher predicts a cause on the basis of a controlled effect (since no variation can be done on the effect which has already taken place on the basis of the independent variable or the cause). Thus, an ex-post facto research can be defined as an empirically based investigation which 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 serious danger of ex-post fact research 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 certain characteristic which distinguishes it from other different types of researches. Some of these characteristics are presented below in the following paragraphs.

- The research has a control or a comparison 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, in order to analyze the cause of an already occurred event.

- The behavior, action, event or the treatment or the independent variable of the research cannot be manipulated or changed as the ex-post research is a kind of study which tries to predict the causes on the basis of actions that have already occurred, the researcher cannot manipulate or change the already occurred actions or behavior.
- The research focuses on the effects since the researcher tries to analyze 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 has 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.
- The research tries to analyze the 'how' and 'what' aspect of an event Since the researcher tries to understand the causal effects behind a phenomena, the research basically focuses on how and what reasons that has led that phenomena to occur.
- Explores possible effects and causes with the help of an ex-post facto research, the researcher tries to analyze the cause and effect phenomena of an event, action or behavior.

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 an ex-post facto research, it is necessary for the researcher to focus on the problem that he or she needs to study. They not only need to find out a problem, they also need to determine, analyze 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 instrument for collecting the required information / data. Once the designing are all finalized, 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 analyze, evaluate and interpret the information collected. It is on basis of this step only; the researcher selects the best possible alternative of causes which might have led the effect to occur.

Advantage and Disadvantage 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:

I. It is considered as a very relevant method in those behavioral 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).

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

III. It is less time consuming as well as economical. Ex-Post Facto Research It gives a chance to the researcher to analyze 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:

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

II. The researcher cannot randomly assign the subjects to different groups.

III. The researcher may not be able to provide a reasonable explanation for the relationship between the independent and dependent variables under study.

2.4.4 Experimental Research

The educational researcher may wish to know what effect may be observed when certain conditions are imposed on subjects. For example, the researcher may want to know the effect on academic achievement of some disciplinary measures taken in schools. To investigate this, the experimenter may impose different degrees of disciplinary measures and study the subsequent improvements in academic achievement. In other words, the researcher deliberately manipulates and controls the conditions and observes the effect it has on certain aspects of the subject. Experimental research imposes differences between groups to ascertain their differences. Experimental research in education most closely resembles scientific research and provides the most sophisticated method of hypothesis testing.

Operational notations of Experimental Research

Depicting designs- Operationally, experimental research consists (at its simplest) of manipulating a variable, called the independent variable and observing its effect on another variable, called the dependent variable. In depicting the design of experimental research, usually adaptations from Campbell and Stanley's [Campbell, D.T. and Stanley, J.C.] symbols are used.

Operations establishing causality in Experimental Research

Experimental research, like Ex-post facto research, establishes causality. The difference being, in experimental research the independent variable is actually manipulated to observe its effect on the dependent variable. Thus the problem of establishing cause and effect, encountered in correlation research is overcome. However, in experimental research, the time order and the purity of observations have to be established. Thus, experimental research involves three operations: demonstrating co-variation, establishing the time order sequence and maintaining non-spuriousness, i.e., maintaining the validity of the experiment.

Research design for experimental research has four components: **comparison, manipulation, control and generalization**. Generalization is the ultimate goal of scientific research.

Comparison: demonstrates that two variables are associated in some manner. If two samples of students are taken and one sample is exposed to a certain treatment while the other is not, then the effect of the treatment is ascertained by comparing observations

on the two samples. This comparison establishes the co-variation of the treatment with certain characteristics of the samples.

Manipulation: indicates the extent of the treatment to be administered on the sample. The total withdrawal of treatment or its variations on the sample form the basis of comparison. Manipulation establishes the time-order.

Control: in an experimental design establishes non-spuriousness and thus the validity of the experiment. By controlling, the researcher rules out other rival explanations of the observations so that the treatment or intervention is established as the independent variable that causes the dependent variable to change. This is called the *internal validity* of the experiment.

Generalizability: is the extent to which the findings can be applied to larger populations or different settings. It is called *external validity.* It depends on the representativeness of the samples in the study. External validity without sufficient internal validity will lead to unreliable results.

Steps in Experimental Research:

The steps of the experimental method are not different from those of a scientific method. For the sake of clarification, the major steps may be described as under:

Surveying the Literature Relating to the Problem

For a worthwhile research based on experimentation, the researcher like in any other type of research needs to acquire up-to-date information relating to his problem.

Selecting and Defining the Problem

Experimental research starts with the selection of the problem which is amenable to experimentation. It needs a rigorous logical analysis and definition of the problem in precise terms. The variables to be studied should be defined in operational terms clearly and unambiguously. It helps the researcher to convert the problem precisely into a hypothesis that can be verified or refuted by the experimental data.

Stating of Hypotheses

The stating of problem hypotheses is one of the distinguishing characteristics of the experimental method. Hypotheses are the heart of experimental research. They suggest that an antecedent condition or phenomenon (independent variable) is related to the occurrence of another condition, phenomenon, event, or effect (dependent variable). To test a hypothesis, the researcher attempts to control all the conditions except the

independent variable which he manipulates. Then he observes the effect on the dependent variable presumably because of the exposure to the independent variable. The researcher, therefore, should not only be concerned primarily with experimental plans and statistical procedures, but should give sufficient attention to the formulation of hypotheses. The experimental plans and statistical procedures merely help him in the testing of hypotheses and contribute little in the development of theories or advancement of knowledge. The hypotheses developed or derived from existing theories, however, contribute to the development of new theories and knowledge.

Constructing the Experimental Plan:

Experimental plan refers to the conceptual framework within which the experiment is conducted. According to Van Dalen it represents all elements, conditions of phenomena, and relations of consequences so as to:

I. Identify all non-experimental variables that might contaminate the experiment and determine how to control them;

II. Select a research design;

III. Select a sample of subjects to represent a given population, assign subjects to groups, and assign experimental treatments to groups;

IV. Select or construct and validate instruments to measure the outcomes of the experiment;

V. Outline procedures for collecting data

VI. State the null hypothesis.

Experimental Designs:

An experimental design is to the researcher what a blueprint is to an architect. It provides the researcher an opportunity for the comparisons required by the hypotheses of the experiment and enables him to make a meaningful interpretation of the results of the study with the help of statistical analysis of the data. There are three important criteria which the researcher must keep in mind while selecting an experimental design for conducting his experiment.

Types of Experimental Designs:

Experimental design is the plan, structure and strategies of an experiment to be conducted. It is the blue-print of the experimental. This is formulated by the researcher before he/she go on to conduct an experiment. It is technically called a control mechanism of the experiments. It follows max-min-con principle.

There are various types of experimental designs. They vary in complexity and adequacy. The selection of a particular design depends upon such factors as the nature and purpose of the experiment, the type of the variables to be manipulated, the nature of the data, the facilities or the conditions for carrying out the experiment, and the competence of the experimenter. Although the designs can be combined into various ways, they are broadly classified as under:

1. Pre-experimental designs
2. Pre-Post designs
3. Quasi-experimental designs
4. Single designs

Pre-experimental Designs

Pre-experimental designs provide little or no control of extraneous or situation variables. They are, however, still being used in the study of educational problems.

There are two types of pre-experimental designs.

Design 1: One Group Pre-test Post-test Design:

When an experimenter uses this design, he measures dependent variable, before the independent variable *X* is applied or withdrawn and then takes its measurement again afterwards. The difference in the measurements of dependent variable, if any, is computed and is, taken as the amount of change as a result of the application or withdrawing of independent or treatment variable.

Illustration

Suppose a teacher wants to evaluate the effectiveness of programmed instruction in teaching general science to sixth grade students. At the beginning of the session he administers a criterion test to a selected group of sixth grade students that seems to be the good measure of the achievement of the objectives in general science for sixth grade and gets the measure T1. Then the group is administered the programmed text on general science, and at the end of the session the teacher administers the criterion test a second time to get the measure *T2*. The means of T1 and *T2* are compared to ascertain what difference, if any, the exposure to *X* (teaching through programmed instruction) has made.

An appropriate statistical technique will be used to ascertain whether the difference is statistically significant.

Pre-test	*Independent variable*	*Post-test*
T1	X	T2
Mean of the criterion test	Teaching through programmed instruction	Mean of the criterion test

Limitations

Since the design involves only one group and one teacher, it seems to control inter subject differences and extraneous variables. The control, however, is superficial and does not check the threats to internal validity because of the following reasons:

1. This design does not use any control group and, therefore, the experimenter cannot assume that the difference between the pretest means T1 and the post-test mean T2 was brought about by the experimental treatment or by some extraneous variables.

2. History and maturation are two major extraneous variables that are not controlled in this design. History refers to the specific events that can occur between the pre-test and the post-test other than the exposure of subjects to the experimental treatment.

3. This design does not provide any procedure for evaluating the effect of post-test itself. There is practice effect when the subjects take a test a second time or even take a parallel form of the test. That is, subjects perform better at the post-test stage even without any teaching.

4. There is a problem of reactivity in the design due to a reaction between the subject and pre-test measure. It is this reaction rather than the treatment variable that produces the change in the post-test measures.

Design 2: Two Groups, Static Design:

To overcome the limitations of Design 1, 'two groups, static design' utilizes two groups, only one of which is exposed to the experimental treatment. The other group which is not exposed to any experimental treatment acts as the control group and this permits the comparison that is required by a scientific investigation. The experimenter assumes the two groups to be equivalent in all relevant aspects at the start of the experimentation.

Illustration

Suppose a teacher wants to evaluate the effectiveness of a new method of teaching in mathematics to X grade students. He will frame two equivalent groups of 30 each from

the same class of 30 students. One group will be taught by the new method and the other one by the conventional method. At the end of the experiment, an achievement test in mathematics is administered to both the groups and a comparison is made of the achievement of students of the two-groups. The means of the post-test T2 will be computed. An appropriate statistical test will be applied to ascertain whether the observed difference is statistically significant.

Group	*Independent variable*	*Post-test*
Experimental	Teaching through new method	T_2
Control	Teaching through conventional	T^2

Limitations

Since neither randomization nor matching is used to assign subjects to the experimental and control groups, the experimenter cannot assume that the groups are equivalent with respect to relevant extraneous variables before they are exposed to the experimental treatment. This design, therefore, is also considered to be lacking in the necessary control.

Quasi-Experimental Designs:

The true experimental design provides full experimental control through the use of randomization procedures. There are many experimental situations in which it is not possible for the experimenter to assign subjects randomly to groups or exercise full control over the scheduling of experimental conditions. In such situations, researcher uses quasi-experimental designs that provide as much control as possible under the existing conditions. If an experimenter uses a quasi-experimental design, it is necessary for him to know which of the variables his design may fail to control. He must also be aware of the sources that represent threats to both internal and external validity and consider them while interpreting the results of the experiment.

Some of the important quasi-experimental designs are discussed as under:

Design: Non-randomized Control Group, Pretest-Posttest Design

In a school situation, it is sometimes practically not possible to upset class schedules, to gather subjects for obtaining a sufficiently large sample or to reorganize classes in order to employ randomization procedures for getting equivalent control and experimental groups. Under these circumstances, therefore, an experimenter may use pre-assembled

groups, such as intact classes, for framing, experimental and control groups. The pre-assembled groups are selected and are administered pretest. The pretest scores are analyzed to show that the means and standard deviations of the two groups do not differ significantly. If the pretest scores for the groups are not equivalent, the experimenter may proceed with the conduct of the experiment by using the technique of analysis of co-variance to compensate for this lack of equivalency between the groups. Once the two groups are obtained, it is advisable to use a random procedure to determine which group is to be assigned to experimental treatment and which one to the controlled condition. After determining the groups the experimental treatment is administered to the experimental group and then the posttest is given to both the groups. The difference between the pre and posttest scores is compared with the help of appropriate statistical test to ascertain the effect of the independent variable.

PARADIGM FOR DESIGN 3:

Non-randomized Control–Group, Pretest-Posttest design:

Group	*Pre-test*	*Independent Variable*	*Post-test*
Exprimental	11	Experimental treatment	T2
Control	TI	Controlled condition	T2

1. The reactive effects of experimentation are more easily controlled.
2. When the preassembled groups are used, subjects are less aware of the fact that they are subjected to the experimental treatment than when the subjects are drawn from class through randomization and put into experimental sessions.
3. The experiments using this design are conveniently conducted in the school situations.

Limitations:

1. The selection or subjects of the experimental and control groups may result in interaction effect between selection and certain extraneous variables like selection and maturation, and selection and history, etc. That could be mistakenly attributed to the effect of independent variable.

2. Statistical regression is a major threat to the internal validity of this design.

3. The sources of threats to external validity in this design are the same as were discussed in the Design.

2.5. Variables:

A variable, as the name implies, is something that varies. This is the simplestway of defining a variable. In other words, variables are anything can effect or change the results of a study. Every study has variables as these are needed in order to understand differences.

However, a behavioral scientist attempts to define a variable more precisely and specifically.

- Kerlinger (1986) defined variable 'a property that taken as different values'.
- According to D'Amato (1970) variables may be defined as those attributes of objects, events, things and beings, which can be measured.

According to Postman and Egan (1949) a variable is a characteristic or attribute that can take on a number of values, for example, number of items that an individual solves on a particular test, the speed with which we respond to a signal, IQ, sex, level of anxiety, and different degree of illumination are the examples of variables that are commonly employed in psychological research.

Types of Variables:

The descriptions of different types of variables are given below:

1. **Independent variable** – the cause supposed to be responsible for bringing about change(s) in a phenomenon or situation.
2. **Dependent variable** – the outcome or change(s) brought about by introduction of an independent variable.
3. **Extraneous variable** – several other factors operating in a real-life situation may affect changes in the dependent variable. These factors, not measured in the study, may increase or decrease the magnitude or strength of the relationship between independent and dependent variables.
4. **Intervening variable** – sometimes called the confounding variable (Grinnell 1988: 203), it links the independent and dependent variables. In certain situations the relationship between an independent and a dependent variable cannot be established without the intervention of another variable. The cause, or independent, variable will have the assumed effect only in the presence of an intervening variable.

2.6. Process of Research

A typical research process comprises the following stages:

1. Selecting the Problem:

You are expected to state that you have selected the research area due to professional and personal interests in the area and this statement must be true. The importance of this first stage in the research process is often underestimated by many students. If you find research area and research problem that is genuinely interesting to you it is for sure that the whole process of writing your dissertation will be much easier. Therefore, it is never too early to start thinking about the research area for your dissertation.

2. Formulating research aim, objectives and research questions or developing hypotheses:

The choice between the formulation of research questions and the development of hypotheses depends on your research approach as it is discussed further below in more details. Appropriate research aims and objectives or hypotheses usually result from several attempts and revisions and these need to be mentioned in Methodology chapter. It is critically important to get your research questions or hypotheses confirmed by your supervisor before moving forward with the work.

3. Conducting the literature review. Literature review is usually the longest stage in the research process. Actually, the literature review starts even before the formulation of research aims and objective; because you have to check if exactly the same research problem has been addressed before. Nevertheless, the main part of the literature review is conducted after the formulation of research aim and objectives. You have to use a wide range of secondary data sources such as books, newspapers, magazines, journals, online articles etc.

4. Selecting methods of data collection. Data collection method(s) need to be selected on the basis of critically analyzing advantages and disadvantages associated with several alternative data collection methods. In studies involving primary data collection, in-depth discussions of advantages and disadvantages of selected primary data collection method(s) need to be included in methodology.

5. Collecting the primary data. Primary data collection needs to be preceded by a great level of preparation and pilot data collection may be required in case of questionnaires. Primary data collection is not a compulsory stage for all dissertations and you will skip this stage if you are conducting a desk-based research.

6. Data analysis:

Analysis of data plays an important role in the achievement of research aim and objectives. Data analysis methods vary between secondary and primary studies, as well as, between qualitative and quantitative studies.

7. Reaching conclusions:

Conclusions relate to the level of achievement of research aims and objectives. In this final part of your dissertation you will have to justify why you think that research aims and objectives have been achieved. Conclusions also need to cover research limitations and suggestions for future research.

8. Completing the research:

Following are the stages of research described above.

2.6.1. Selection of Research Problem:

Any research begins with a problem — still earlier with a question. If answer to the question is well known or obvious, it is not a problem. If the answer is unknown for the time being but the probability of finding out the answer is very high, it may be a problem. There is a reference to time and space regarding this issue. Answer to a question may be unknown to the researcher, but known to most of the other people or it may be unknown to a few people in a small part of the country but known to many others in other countries, still it is not a problem. It is a question but not a research question. Before germs were discovered nobody had the answer to a question why milk gets sour or thousands of people die of Small Pox every year. Therefore, it was a problem for a prolonged period of time all over the world. Therefore, we need to understand what a problem is.

What is a Problem?

The question in the subtitle better is asked as what is a research problem. Normally problem is a barrier to knowledge which is a motivator in nature. When one overcomes the barrier, he is able to know and his motivation to know that particular event ceases tentatively until there is a new goal set for further knowledge. A researcher finds a problem for research which means that he has a goal and achieving that goal is not straight forward, it has many barrier or obstacles. The researcher only knows how to overcome the obstacles and reach the goal. He, step by step proceeds to scale the mountains in between his existing knowledge and the destination. When he is successful, he acquires new knowledge or modifies his existing knowledge.

Any question or problem is not a research question or research problem. A research problem has several characteristics:

- A problem originates from the bed of existing knowledge system. This means that a research problem does not arise out of blue. Any inconsistency, controversy, incoherence, gap in knowledge, unanswered questions, or real life or natural phenomena may be a source of research problem.
- A research problem should be of such a nature that it can be expressed in the form of a very small, precise but simple statement.
- A research problem must not include large number of issues, so that it becomes self contradictory.
- A research problem must be logical and be stated using appropriate scientific terminology.
- The problem should be research worthy. Meaning of research worthiness of a problem needs a little elaboration, which will be taken up later.

Identification of Research Problems

It has already been mentioned that a research problem is selected or identified from the existing knowledge. Therefore, it is expected that the intending researcher have a thorough knowledge of the specialized area of her researcher. The simple principles of identifying a research problem are as follow:

- **From known to unknown** — what is unknown can be identified only when one knows what is known. This means that the researcher must know at first, what is already known.
- **From easy to difficult** — Easiness and difficulty are the closest kins of known and unknown. When we know something, it is easy, unknown is difficult. When you did not know to operate a computer, it was difficult. When you learn, it becomes easy.
- **From concrete to abstract** — Research problems are sometimes identified from the known facts, concrete episodes or the like.
- **From simple to complex** — Research problems usually are relational statements meaning that directly or indirectly, they intend to explore relationships. Therefore, the research problem begins with simple statement expecting relationship among a set of factors, events, etc.

- **From general to specific** — The research problems are identified step by step. Then researcher studies in general the specific area of discipline from where she / he are likely to identify the problem. Gradually she narrows down her focus from specialized area to a topic, from a topic to a specific problem.

Apart from these principles, research problems are identified following the procedures given below:

1. Extensive studies to maximize the basic knowledge in the area of research.
2. Extensive search for the variety of research reports to understand the nature of research in the concerned area.
3. Critical evaluation of the problems, methods, and findings in these research reports.
4. Pointing out the theoretical inconsistencies, methodological weaknesses, controversies and contradictions, gap in knowledge and logical fallacies, if any.
5. Selection of a tentative problem and writing the problem in a number of alternative ways.
6. Repeated editing and finalization of the problem.

But these are just a set of general steps. There may be wide variation in these steps. A Problem must be stated and the problem statement involves some variables and it tends to find out the relations between/among two or more variables. Then the analysis of the problem may be summarized with the help of the following sequences:

1. Accumulate the facts that might be related to the nature of the problem.
2. Set observation to see whether the facts are relevant to the problem at hand.
3. Trace relationships between facts that might reveal the key to the difficulty felt.
4. Propose various explanations for the cause of the difficulty.
5. Ascertain through observation and analysis whether they are relevant to the problem.
6. Trace relationship between explanations that might give an insight into the problem solution.
7. Trace relationship between facts and explanations.
8. Formulate the problem statement by connecting empirically verifiable facts and explanations.
9. Question assumptions underlying the analysis of the problem.

Criteria of a Problem Statement

A constructed problem statement should be research-worthy which may be qualified by the following determinations. The Problem (Statement):—

1. Must be relevant to the felt difficulty,
2. Must specify relations between or among variables either continuous/discrete or qualitative/quantitative,
3. Must have defined boundary as well as given conditions, after its solution must be significant either theoretically or practically,
4. Should be feasible to solve within the limits of available resources — time, money, manpower, etc.
5. must be solvable — (a) must qualify the objects of scientific inquiry, (b) it is solvable if, and only if, it is possible to advance a testable hypothesis (proposition) as a tentative solution of it, or to advance research questions, (c) a solvable problem is one for which a hypothesis that is testable by the truth criterion can be stated. Then it appears that the problem statement needs some transformation for making testable or for empirical verification under the purview of theories of testability advanced by the scientific inquiry supported by logic.

Analysis of the Research Problem

Briefly, the purpose of analysis is to examine research worthiness of the problem and its refinement in every respect on the following counts.

- Whether the problem is precise enough.
- Does it reflect any personal bias of the researcher?
- Is it a repetition of a problem researched earlier?
- What kind of concepts/variables is involved?
- Is it feasible?
- Is the researcher competent enough and/or eligible to undertake the research?
- Is there any methodological and ethical constraint?

There may be some other issues of similar nature but initial consideration of these is not enough. The reason may well be evident when we understand the meaning of research worthy problem.

2.6.2. Review of Related Studies

It is already mentioned that research involves a lot of searching at the initial stage as well as at the concluding stage. The task of searching before finalization of the problem is given a general name review of literature or review of related studies or the like. But by the word 'review' we mean something more than mere collection of research reports.

Meaning of Review

Etymologically, the word review means to look into something again. Dictionary meaning refers to re-examine or critical evaluation. Review in research parlance is a combination of all these meanings. In order to review related studies the researcher needs to follow a series of steps.

- At the first phase it is necessary to collect titles from various sources which appear to be relevant. Books on the specific area, articles in edited books, research papers from journals, abstracts from internet, etc. provide the source of information. A provisional bibliography is prepared for future references.
- An initial screening follows to eliminate those appear not much relevant.
- The researcher goes through the selected books, articles, journals and takes necessary note on

1. the problem,
2. theoretical foundation,
3. sample,
4. tools used,
5. mode of data analysis and conclusions.

Then these are examined to find what bearing these have upon the study in question, whether there is any methodological weakness, if the interpretations are adequate and if the results of different studies show any contradiction. The researcher may identify if there is any gap of knowledge or if further works are implied in the conclusions.

The reviewed research studies are classified and a summary of review is prepared with necessary comments on the researcher's part. Thus, the meaning of review of related studies, is best manifested through the steps as in above.

Purpose of Review

Obviously, this refers to the question, why do we at all take so much pain for review of literature. Is it only an academic exercise or it has any practical utility?

Academic purposes of the review are by this time quite obvious to the readers but the other side of usefulness is by no means negligible. The following issues may be highlighted.

- After thorough review of literature the researcher gets convinced about the need of his / her research.
- She / he can understand whether the selected problem is researchable.
- She / he can get necessary help about the planning of her research — his / her design, sample, tools, analysis etc.
- She / he can gather logical or empirical support for his / her points of view.
- The bibliography prepared initially may well be incorporated into his / her own bibliography.
- At the end of research, she / he can compare her own conclusions with those of others.
- The researcher can ascertain the merit of his / her own research in comparison to similar other studies and the originality of her work, if any.

Therefore, review of research reports is a function which begins before a research project commences but continues up to the end which makes it an integral part of any research study.

2.6.3. Sampling

Types of Sampling Designs

Several meth ods have been devised to select representative samples. In general two types of techniques of sampling are as follows:

1. **Probability Sampling:** Method of sampling which gives the probability that our sample is representative of population is known as probability sampling.
2. **Non-probability Sampling**: If there is no such idea of probability then the method of sampling is known as non- probability sampling. Non-probability sampling is generally used in Action Research (A.A.), since in A.R. we study a class without any generalization purpose.

Characteristics of Probability Sampling

The following are the main characteristics of probability sampling:

1. In probability sampling we refer from the sample as well as the population.

2. In probability sampling every individual of the population has equal probability to be taken into the sample.
3. Probability sample may be representative of the population.
4. The observations (data) of the probability sample are used for the inferential purpose.
5. Probability sample has not from distribution for any variable.
6. Inferential or parametric statistics are used for probability sample.
7. There is a risk for drawing conclusions from probability sample.
8. The probability is comprehensive. Representativeness refers to characteristic. Comprehensiveness refers to size and area.

Characteristics of Non-probability Sampling: The following are the main characteristics of non-probability sample:

1. There is no idea of population in non-probability sampling.
2. There is no probability of selecting any individual.
3. Non-probability sample has free distribution.
4. The observations of non-probability sample are not used for generalization purpose.
5. Non-parametric or non-inferential statistics are used in non probability sample.
6. There is no risk for drawing conclusions from non-probability sample.

1. Types or Techniques Probability Sampling: There are a number of techniques of taking probability sample. But here only six important techniques have been discussed as follows:

1. Simple random sampling.
2. Systematic sampling.
3. Stratified sampling.
4. Multiple or double sampling.
5. Multi-stage sampling.
6. Cluster sampling.

2. Types of Non-probability Sample

There are the following four types of non-probability sample:

(1) Incidental or accidental sample.

(2) Purposive sample.

(3) Quota sample.

(4) Judgement sample.

Probability Sampling

1. Simple Random Sampling

A simple random sample is one in which each element of the population has an equal and independent chance of being included in the sample i.e. a sample selected by randomization method is known as simple-random sample and this technique is simple random-sampling. Randomization is a method and is done by using a number of techniques as :

(a) Tossing a coin.

(b) Throwing a dice.

(c) Lottery method.

(d) Blind folded method.

(e) By using random table of Tippett's Table.

Advantages:

(a) It requires a minimum knowledge of population.

(b) It is free from subjectivity and free from personal error.

(c) It provides appropriate data for our purpose.

(d) The observations of the sample can be used for inferential purpose.

Disadvantages:

(a) The representativeness of a sample cannot be ensured by this method.

(b) This method does not use the knowledge about the population.

(c) The inferential accuracy of the finding depends upon the size of the sample.

2. Systematic Sampling

Systematic sampling is an improvement over the simple random sampling. This method requires the complete information about the population. There should be a list of

information's of all the individuals of the population in any systematic way. Now we decide the size of the sample.

Let sample size = n and population size = N

Now we select each N/nth individual from the list and thus we have the desired size of sample which is known as systematic sample. Thus for this technique of sampling population should be arranged in any systematic way.

Advantages

(a) This is a simple method of selecting a sample.

(b) It reduces the field cost.

(c) Inferential statistics may be used.

(d) Sample may be comprehensive and representative of population.

(e) Observations of the sample may be used for drawing conclusions and generalizations.

Disadvantages

(a) This is not free from error, since there is subjectivity due to different ways of systematic list by different individuals. Knowledge of population is essential.

(b) Information of each individual is essential.

(c) This method can't ensure the representativeness.

(d) There is a risk in drawing conclusions from the observations of the sample.

3. Stratified Sampling:

It is an improvement over the earlier method. When employing this technique, the researcher divides his population in strata on the basis of some characteristics and from each of these smaller homogeneous groups (strata) draws at random a predetermined number of units. Researcher should choose that characteristic or criterion which seems to be more relevant in his research work.

Stratified sampling may be of three types:

1. Disproportionate stratified sampling.
2. Proportionate stratified sampling.
3. Optimum allocation stratified sampling.

1. Disproportionate sampling means that the size of the sample in each unit is notproportionate to the size of the unit but depends upon considerations involving personal judgment and convenience. This method of sampling is more effective for comparing strata which have different error possibilities. It is less efficient for determining population characteristics.

2. Proportionate sampling refers to the selection from each sampling unit of a sample that is proportionate to the size of the unit. Advantages of this procedure include representativeness with respect to variables used as the basis of classifying categories and increased chances of being able to make comparisons between strata.

Lack of information on proportion of the population in each category and faulty classification may be listed as disadvantages of this method.

3. Optimum allocation stratified sampling is representative as well as comprehensive than other stratified samples. It refers to selecting units from each stratum should be in proportion to the corresponding stratum the population. Thus sample obtained is known as optimum allocation stratified sample.

These three types are clear from the table as given below:

Levels	*Disproportionate*	*Proportionate*	*Optimum allocation*	
Str. Sampling	*str. Sampling*	*stratified Sampling*		
Population	*Sample*			
H.G.	35	25	250	25
A. G.	43	50	400	40
L. G.	22	25	350	35
Sample	100	100	1000	100

Advantages

(a) It is (more precisely third way) a good representative of the population.

(b) It is an improvement over the earlier.

(c) It is an objective method of sampling.

(d) Observations can be used for inferential purpose.

Disadvantages:

(a) Serious disadvantage of this method is that it is difficult for the researcher to decide the relevant criterion for stratification.

(b) Only one criterion can be used for stratification, but it generally seems more than one criterion relevant for stratification.

(c) It is costly and time consuming method.

(d) Selected sample may be representative with reference to the used criterion but not for the other.

(e) There is a risk in generalization.

4. Multiple or Double or Repetitive Sampling:

Generally this is not a new method but only a new application of the samplings we discussed above. This is most frequently used for establishing the reliability of a sample. When employing a mailed questionnaire, double sampling is sometimes used to obtain a „more representative sample. This is done because some randomly selected subjects who are sent questionnaires may not return them. Obviously, the missing data will bias the result of the study, if the people who fail to reply the query differ in some fundamental way from the others in respect to the phenomena being studied. To eliminate this bias, a second sample may be drawn at random from the non-respondents and the people interviewed to obtain the desired information. Thus this technique is also known as repeated or multiple sampling. This double sampling technique enables one to check on the reliability of the information obtained from the first sample. Thus, double sampling, wherein one sample is analyzed, and information obtained is used to draw the next sample to examine the problem further.

Advantages:

(a) This sampling procedure leads to the inferences of free determine precision based on a number of observations.

(b) This technique of sampling reduces the error.

(c) This method maintains the procedure of the finding evaluate the reliability of the sample.

Disadvantages:

(a) This technique of sampling cannot be used for a large sample. It is applicable only for small sample.

(b) This technique is time consuming, costly, and requires more competition.

(c) Its planning and administration is more complicated.

5. Multi-Stage Sampling:

This sample is more comprehensive and representative of the population. In this type of sampling primary sample units are inclusive groups and secondary units are sub-groups within these ultimate units to be selected which belong to one and only one group. Stages of a population are usually available within a group or population, whenever stratification is done by the researcher. The Individuals are selected from different stages for constituting the multi-stage sampling.

Advantages:

(a) It is a good representative of the population.

(b) Multi-stage sampling is an improvement over the earlier methods.

(c) It is an objective procedure of sampling.

(d) The observations from multi-stage sample may be used for inferential purpose.

Disadvantages:

(a) It is a difficult and complex method of samplings.

(b) It involves errors when we consider the primary and secondary stages.

(c) It is again a subjective phenomenon.

6. Cluster Sampling:

To select the intact group as a whole is known as a Cluster sampling. In Cluster sampling the sample units contain groups of elements (clusters) instead of individual members or items in the population. Rather than listing all elementary school children in a given city and randomly selecting 15 per cent of these students for the sample, a researcher lists all of the elementary schools in the city, selects at random 15 per cent of these clusters of units, and uses all of the children in the selected schools as the sample.

Advantages:

(a) It may be a good representative of the population.

(b) It is an easy method.

(c) It is an economical method.

(d) It is practicable and highly applicable in education.

(e) Observations can be used for inferential purpose.

Disadvantages:

(a) Cluster sampling is not free from error.

(b) It is not comprehensive.

All these above are techniques of probability sampling.

Non-probability Sampling Techniques:

Non-probability is also known as non-parametric sampling which ate used for certain purpose.

1. Incidental or Accidental Assignment

The term incidental or accidental applied to those samples that are taken because they are most frequently available, i.e. this refers to groups which are used as samples of a population because they are readily available or because the researcher is unable to employ more acceptable sampling methods.

Advantages

(a) It is very easy method of sampling.

(b) It is frequently used in behavioral sciences.

(c) It reduces the time, money and energy i.e. it is an economical method.

Disadvantages

(a) It is not a representative of the population.

(b) It is not free from error.

(c) Parametric statistics cannot be used.

2. Judgment Sampling

This involves the selection of a group from the population on the basis of available information thought. It is to be representative of the total population. Or the selection of a group by intuition on the basis of criterion deemed to be self-evident. Generally investigator should take the judgement sample so this sampling is highly risky.

Advantages

(a) Knowledge of the investigator can be best used in this technique of sampling.

(b) This technique of sampling is also economical.

Disadvantages

(a) This technique is objective.

(b) It is not free from error.

(c) It includes uncontrolled variation.

(d) Inferential statistics cannot be used for the observations of this sampling, so generalization is not possible.

3. Purposive Sampling:

The purposive sampling is selected by some arbitrary method because it is known to be representative of the total population, or it is known that it will produce well matched groups.

The Idea is to pick out the sample in relation to some criterion, which are considered important for the particular study. This method is appropriate when the study places special emphasis uponthe control of certain specific variables.

Advantages:

(a) Use of the best available knowledge concerning the sample subjects.

(b) Better control of significant variables.

(c) Sample groups data can be easily matched.

(d) Homogeneity of subjects used in the sample.

Disadvantages:

(a) Reliability of the criterion is questionable.

(b) Knowledge of population is essential.

(c) Errors in classifying sampling subjects.

(d) Inability to utilize the inferential parametric statistics.

(e) Inability to make generalization concerning total population.

4. Quota Sampling:

This combined both judgment sampling and probability sampling. The population is classified into several categories: on the basis of judgment or assumption or the previous knowledge, the proportion of population falling into each category is

decided. Thereafter a quota of cases to be drawn is fixed and the observer is allowed to sample as he likes. Quota sampling is very arbitrary and likely to figure in Municipal surveys.

Advantages:

(a) It is an improvement over the judgment sampling.

(b) It is an easy sampling technique.

(c) It is most frequently used in social surveys.

Disadvantages:

(a) It is not a representative sample.

(b) It is not free from error.

(c) It has the influence of regional geographical and social factors.

Since research design is a plan by which research samples may be selected from a population and under which experimental treatments are administered and controlled so that their effect upon the sample may be measured. Therefore, a second step in the establishment of an experimental design is to select the treatments that will be used to control sources of learning change in the sample subjects.

Characteristics of a Good Sample:

The following are the main characteristics of a good sample:

1. A good sample is the true representative of the population corresponding to its properties. The population is known as aggregate of certain properties and sample is called sub-aggregate of the universe.
2. A good sample is free from bias, the sample does not permit prejudices the learning and preconception, imaginations of the investigator to influence its choice.
3. A good sample is an objective one, it refers objectivity in selecting procedure or absence of subjective elements from the situation.
4. A good sample maintains accuracy. It yields an accurate estimates or statistics and does not involve errors.
5. A good sample is comprehensive in nature. This feature of a sample is closely linked with true-representativeness. Comprehensiveness is a quality of a sample

which is controlled by specific purpose of the investigation. A sample may be comprehensive in traits but may not be a good representative of the population.

6. A good sample is also economical from energy, time and money point of view.
7. The subjects of good sample are easily approachable. The research tools can be administered on them and data can be collected easily.
8. The size of good sample is such that it yields an accurate results. The probability of error can be estimated.
9. A good sample makes the research work more feasible.
10. A good sample has the practicability for research situation.

Selection Process of Sampling:

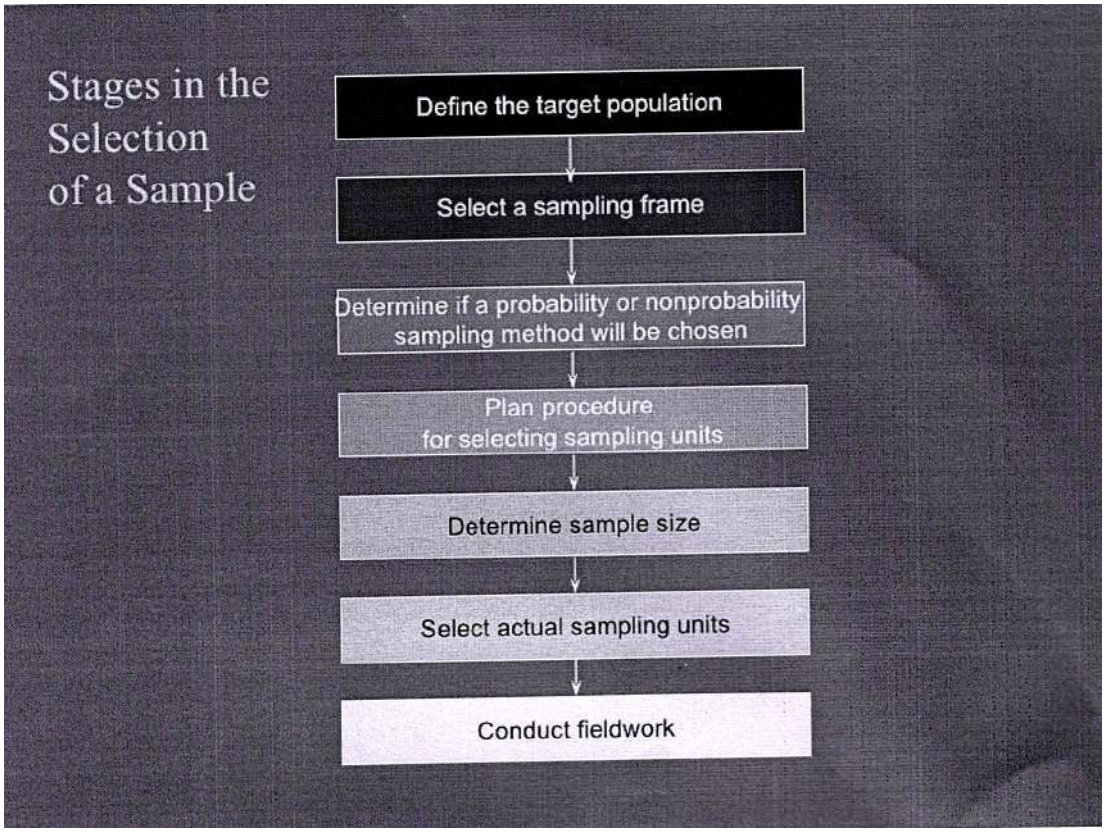
The objective of selecting a sample is to achieve maximum accuracy in your estimation within a given sample size and to avoid bias in the selection of the sample. This is important as bias can attack the integrity of facts and jeopardize your research outcome.

Table 1.1: Reasons Bias Occurs in Sample Selection

No.	Reasons
1.	Sampling done using non-random method (we will see sampling designs in the next section) which can be influenced by human choices.
2.	Sampling frame like list, indexing and records which serve as the platform of selection does not cover the sampling population accurately or completely.
3.	A section of sampling population refuses to co-operate.

There are also factors that may influence the degree of certainty in inferences drawn from a sample for research study. As we know, the size of samples influences findings such that large samples have more certainty than those based on smaller ones. Therefore, the larger the sample, the researcher will obtain more accurate findings.

Another factor is the extent of variation in the sampling population where the greater the variation in the population will have greater uncertainty with respect to its characteristics. Therefore, it is crucial for a researcher to bear these in mind especially when selecting a sample for her/his respective research work.



2.6.4. Hypothesis

Meaning of Hypothesis

The word hypothesis is made up of two Greek roots which mean that it is some sort of "sub statements", for it is the presumptive statement of a proposition, which the investigation seeks to prove. The scientist observes the man of special class of phenomena and broads over it until by a flash of insight he perceives an order and intelligent harmony in it. This is often referred to as an "explanation" of the facts he has observed. He has a "theory" about particular mass of fact. This theory when stated testable proposition formally and clearly subjected to empirical or experimental verification is known as a hypothesis.

The hypothesis furnishes the germinal basis of the whole investigation and remains to the end its corner stone, for the whole research is directed to test it out by facts. At the start of investigation the hypothesis is a stimulus to critical thoughts offers insights into the confusion of phenomena. At the end it comes to prominence as the proposition to be accepted or rejected in the light of the findings. The word hypothesis consists of two

words: Hypo + thesis = Hypothesis "Hypo" means tentative or subject to the verification and „Thesis means statement about solution of a problem. The meaning of the term hypothesis is a tentative statement about the solution of the problem. Hypothesis offers a solution of the problem that is to be verified empirically and based on some rationale.

Definitions of Hypothesis

The term hypothesis has been defined in several ways. Some important definitions have been given in the following paragraphs:

A tentative supposition or provisional guess "It is a tentative supposition or provisional guess which seems to explain the situation under observation." – James E. Greighton

Lungberg thinks "A hypothesis is a tentative generalization the validity of which remains to be tested. In its most elementary stage the hypothesis may be any hunch, guess, imaginative idea which becomes the basis for further investigation."

Goode and Han, "A hypothesis states what we are looking for. A hypothesis looks forward. It is a proposition which can be put to a test to determine its validity. It may prove to be correct or incorrect.

Bruce W. Tuckman, "A hypothesis then could be defined as an expectation about events based on generalization of the assumed relationship between variables."

Nature of Hypothesis:

The following are the main features of a hypothesis:

1. It is conceptual in nature. Some kind of conceptual elements in the framework are involved in a hypothesis.
2. It is a verbal statement in a declarative form. It is a verbal expression of ideas and concepts, it is not merely idea but in the verbal form, the idea is ready enough for empirical verification.
3. It has the empirical referent. A hypothesis contains some empirical referent. It indicates the tentative relationship between two or more variables.
4. It has a forward or future reference. A hypothesis is future oriented. It relates to the future verification not the past facts and information's.
5. It is the pivot of a scientific research. All the research activities are designed for its verification.

   The nature of hypothesis can be well understood by differentiating it with other terms like assumption and postulate.

Functions of Hypothesis:

The following are the main functions of hypothesis in the research process suggested by H.H. Mc. Ashan :

1. It is a temporary solution of a problem concerning with some truth which enables an investigator to start his research work.
2. It offers a basis in establishing the specifics what to study for and may provide possible solutions to the problem.
3. Each hypothesis may lead to formulate another hypothesis.
4. A preliminary hypothesis may take the shape of final hypothesis.
5. Each hypothesis provides the investigator with definite statement which may be objectively tested and accepted or rejected and leads for interpreting results and drawing conclusions that is related to original purpose.

Importance of a Hypothesis

1. **Hypothesis as the Investigators Eyes**

   Carter V. Good thinks that by guiding the investigator in further investigation it serves as the investigator's "Eyes" in seeking answers to tentatively adopted generalization.

2. It Focuses Research

Without it, research is unfocussed research and remains like a random empirical wandering. It serves as necessary link between theory and the investigation.

3. It Places Clear and Specific Goals

A well thought out set of hypothesis is that they place clear and specific goals before the research worker and provide him with a basis for selecting sample and research procedure to meet these goals.

4. It Links Together

"It serves the important function of linking together related facts and information and organizing them into wholes." *– Good Barr and Scates*

5. It Prevents Blind Research

"The use of hypothesis prevents a blind search and indiscriminate gathering of masses of data which may later prove irrelevant to the problem under study." *– P. V. Young*

6. As a Sort of Guiding Light

A hypothesis serves as a powerful beacon those lights the way for the research work.

Van Dalen advocates the Importance of Hypothesis in the following ways:

1. Hypotheses are indispensable research instrument, for they build a bridge between the problem and the location of empirical evidence that may solve the problem.
2. A hypothesis provides the map that guides and expedites the exploration of the phenomena under consideration.
3. A hypothesis pin points the problem. The investigator can examine thoroughly the factual and conceptual elements that appear to be related to a problem.
4. Using hypothesis determines the relevancy of facts. A hypothesis directs the researcher's efforts into productive channels.
5. The hypothesis indicates not only what to look for is an investigation but how to obtain data. It helps in deciding research design. It may suggest what subjects, tests, tools, and techniques are needed.
6. The hypothesis provides the investigator with the most efficient instrument for exploring and explaining the unknown facts.
7. A hypothesis provides the framework for drawing conclusions.
8. These hypotheses simulate the investigator for further research studies.

Types of Hypotheses:

Hypotheses vary in form and some extent, form is determined by some function. Thus a working hypothesis or a tentative hypothesis is described as the best guess or statement derivable from known or available evidence. The amount of evidence and the certainty or quality of it determines other forms of hypotheses. In other cases, the type of statistical treatment generates a need for a particular form of hypothesis.

The following kinds of hypotheses and their examples represent an attempt to order the more commonly observed varieties as well as to provide some general guidelines for hypothesis, development and statement. There are four kinds of hypotheses: (a) Question (b) Declaration Statement (c) Directional Statement and (d) Null form or Non-Directional.

(a) Question form of Hypotheses:

Some writers assert that a hypothesis may be stated as a question; however, there is no general consensus on this view. At best, it represents the simplest level of empirical observation. In fact, it fails to fit most definitions of hypothesis. It is included here for two reasons: the first of which is simply that it frequently appears in the lists. The second reason is not so much that question may or may not qualify as a hypothesis. There are cases of simple investigation and search which can be adequately implemented by raising a question, rather than dichotomize hypothesis forms into acceptable/ rejectable categories. The following example of a question is used to illustrate the various hypothesis forms:

a) Is there a significant interaction effect of schedule of reinforcement and extroversion on learningoutcomes?

(b) Declarative Statement: A hypothesis may be developed as a declarative which provide an anticipated relationship or difference between variables. The anticipation of a difference between variables would imply that the hypothesis developer has examined existing evidence which led him to believe a difference may be anticipated as processes additional evidence.

The following is an example of this form of hypothesis

H : There is significant interaction effect of schedule of reinforcement and extroversion on learning outcomes. It is merely a declaration of the independent variables effect on the criterion variable.

(c) Directional Hypothesis: A hypothesis may be directional which connotes an expected direction in the relationship or difference between variables. The above hypothesis has been written in directional statement form as follows:

H: Extrovert learns better through intermittent schedule of reinforcement whereas introvert learns through continuous schedule of reinforcement.

The hypothesis developer of this type appears more certain of his anticipated evidence than would be the case if he had used either of the previous examples. If seeking a tenable hypothesis is the general interest of the researcher, this kind of hypothesis is less safe than the others because it reveals two possible conditions. These conditions are matter of degree. The first condition is that the problem of seeking relationship between variables is so obvious that additional evidence is scarcely needed. The second condition derives because researcher has examined the variables very thoroughly and the available evidence supports the statement of

particular anticipated outcomes. An example of the obviously safe hypothesis would be „hypotheses that high intelligence students learn better than low intelligent students. The above hypothesis is in the directional statement form but it requires evidence for the relationship of these two variables reinforcement and personality.

(d) **Non-Directional Hypothesis:** A hypothesis may be stated in the null form which is an assertion that no relationship or no difference exists between or among the variables. This form null hypothesis is a statistical hypothesis which is testable within the framework of probability theory. It is also a non- directional form of hypothesis. The following are the examples of null form of hypothesis

H0: There is no significant interaction effect of schedule of reinforcement and extroversion on learning outcomes.

Characteristics of a Good Hypothesis

A good hypothesis must possess the following main characteristics:

1. A good hypothesis is in agreement with the observed facts.
2. A good hypothesis does not conflict with any law of nature which is known to be true.
3. A good hypothesis is stated in the simplest possible term.
4. A good hypothesis permits of the application of deductive reasoning.
5. A good hypothesis shows very clear verbalization. It is different from what is generally called hunch.
6. A good hypothesis ensures that the methods of verification are under control of the investigator.
7. A good hypothesis guarantees that available tools and techniques will be effectively used for the purpose of verification.
8. A good hypothesis takes into account the different types controls which are to be exercised for the purpose of verification.
9. A good hypothesis ensures that the sample is readily approachable.
10. A good hypothesis indicates clearly the role of different variables involved in the study.
11. A good hypothesis maintains a very apparent distinction with what is called theory law, facts, assumption and postulate.

2.6.5. Research Instruments

These are the fact finding strategies. They are the tools for data collection. There is no doubt that in Educational Research, data collection, forms an essential component of the research process. This is because it enables the researcher to obtain relevant information or gain the experience of others from which he or she imbibes lessons for the enrichment of his report. In this respect, different procedures and data collection instruments have to be employed. These principally include questionnaire, interview, observation, reading and transcribing. Since data collected specifically in qualitative research has to help in answering research questions, the researcher must carefully select the informants (respondents) to be interviewed or administered with questionnaire

He must carefully choose relevant documents to be read or visual materials to be observed. This means that research question or statement of hypothesis significant in quantitative research determines the appropriate data collection instrument for a research. Essentially the researcher must ensure that the instrument chosen is valid and reliable. In data collection, it is important to find out which instrument or tool will better serve the purpose of the study, in order to obtain the right information that will answer the research questions. Please note that the validity and reliability of any research project depends largely on the appropriateness of such instruments. Whatever procedure one uses to collect data, it must primarily be critically examined to check the extent at which it is likely to give you the expected results. Today, the use of both digital and analogue recorders enhances data collection. Technical gadgets such as the audio and video recorders, cameras, telephones, computers, fax, and e- mail systems have gained importance as auxiliary tools and equipment in the data collection processes. Sketching in drawing is one of the traditional artistic skills, by which fine artists, industrial designers and architectural designers collect data for studio and design-based research.

Tools of Data Collection:

A researcher requires many data – gathering tools or techniques. Tests are the tools of measurement and it guides the researcher in data collection and also in evaluation. Tools may vary in complexity, interpretation, design and administration. Each tool is suitable for the collection of certain type of information.

One has to select from the available tools those which will provide data he seeks for testing hypothesis. It may happen that existing research tools do not suit the purpose in some situation, so researcher should modify them or construct his own.

Different tools used for data collection may be;

1. Tests
2. Questionnaires
3. Interviews
4. Schedules
5. Observation Techniques
6. Rating Scales

2.6.5.1. Tests

As data gathering devices, tests are among the most useful tools of educational research, for they provide the data for most experimental and descriptive studies in education. The instruments have been designed to describe and measure sample of aspects of human behavior. These instruments assess variety of human abilities, potentials achievements and behavior tendencies. They possess different degrees of validity reliability and applicability.

Types of Tests

The following types of tests designed for different purposes are briefly described.

A. Achievement Test

Achievement tests attempt to measure what an individual has learned his present level of performance. Most tests used in schools are achievement tests. They are particularly helpful in determining individual or group status in academic learning. Achievement test scores are used in placing, advancing or retaining students at particular grade revels.

B. Aptitude Test

Aptitude tests seek to assess the level of achievement that an individual can attain in some particular academic or vocational field. In other words, aptitude tests attempt to predict an individual capacity to require improved performance with additional training.

C. Personality Test

It is concerned with the non-intellectual aspect of human behavior. Personality scales are usually self report instruments. The individual checks responses to certain questions or statements. These instruments yield scores. Which are assumed or have been shown to measure certain personality traits or tendencies?

Qualities of a Good Test

The qualities of a good test are:

Validity; in general a test possesses validity to the extent that it measures what it claims to measure.

It is **reliable** A test is reliable to the extent that it measures accurately and consistently, from one time to another.

Objectivity: A test should yield a clear score value for each performance the score being independent of the personal judgment of the scorer.

2.6.5.2. Questionnaire

It is list of questions related to one topic. It may be defined as;

"A questionnaire is a systematic compilation of questions that are submitted to a sampling of population from which information is desired."

Barr, Davis & Johnson

"In general, the word questionnaire refers to a device for securing answers to questions by using a form which the respondent fills in him."

W. J. Goode & K. Hall

- The questionnaire is probably most used and most abused of the data gathering devices .It is easy to prepare and to administer.
- The 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 which the respondent will fill by himself.
- It is a systematic compilation of questions. It is an important instrument being used to gather information from widely scattered sources. Normally used where one cannot see personally all of the people from whom he desires responses or where there is no particular reason to see them personally.

Characteristics of a Good Questionnaire

1. It deals with an important or significant topic.
2. Its significance is carefully stated on the questionnaire itself or on its covering letter.
3. It seeks only that data which cannot be obtained from the resources like books, reports and records.
4. It is as short as possible, only long enough to get the essential data.
5. It is attractive in appearance, nearly arranged and clearly duplicated or printed.

6. Directions are clear and complete, important terms are clarified.
7. The questions are objective, with no clues, hints or suggestions.
8. Questions are presented in a order from simple to complex.
9. Double negatives, adverbs and descriptive adjectives are avoided.
10. Double barreled questions or putting two questions in one question are also avoided.
11. The questions carry adequate number of alternatives.
12. It is easy to tabulate, summarize and interpret.

Merits of Questionnaire Method

1. it's very economical.
2. It's a time saving process.
3. It covers the research in wide area.
4. It's very suitable for special type of responses.
5. It is most reliable in special cases.

Demerits of Questionnaire Method:

1. Through this we get only limited responses.
2. Lack of personal contact.
3. Greater possibility of wrong answers.
4. Chances of receiving incomplete response are more.
5. Sometimes answers may be illegible.
6. It may be useless in many problems.

2.6.5.3. The Interview

Interview is a two way method which permits an exchange of ideas and information.

"Interviewing is fundamentally a process of social interaction." ***W. J. Goode & P.K. Hatt***

"The interview constitutes a social situation between two persons, the psychological process involved requiring both individuals mutually respond though the social research purpose of the interview call for a varied response from the two parties concerned." ***Vivien Palmar***

"The interview may be regarded as a systematic method by which a person enters more or less imaginatively into the inner life of a comparative stranger." ***P.V. Young***

- In an interview a rapport is established between the interviewer and the interviewee. Not only is physical distance between them annihilated, the social and cultural barrier is also removed; and a free mutual flow of ideas to and from takes place. Both create their respective impression upon each other.
- The interview brings them both on the same level and an emotional attachment supervenes between them.
- In an interview all formalities are laid down and the gate is opened for delivering into the intellectuals, emotional and subconscious stirrings of the interviewee. Thus here the 'depth' of subject (man) is gone to the very bottom of his emotional pool and may check his truthfulness of responses.

Characteristics of an Interview:

1. The interviewer can probe into casual factors, determine attitudes, and discover the origin of problem.
2. Its appropriate to deal with young children and illiterates person.
3. It can make cross questioning possible.
4. It helps the investigator to gain an impression of the person concerned.
5. It can deal with delicate, confidential and even intimate topics.
6. It has flexibility.
7. Sincerity, frankness, truthfulness and insight of the interviewee can be better judged through cross questioning.
8. It gives no chance for respondent to modify his earlier answer.
9. It is applicable in survey method, but it is also applicable in historical, experimental, case studies and clinical studies.

Merits of Interview:

1. Direct research.
2. Deep research
3. Knowledge of past and future.
4. Knowledge of special features.

5. Mutual encouragement is possible.
6. Supra-observation is possible.
7. Knowledge of historical and emotional causes.
8. Examination of known data.

Demerits of Interview:

1. May provides misleading information.
2. Defects due to interviewee (low level of intelligence or may be emotionally unbalanced)
3. Result may be affected due to prejudices of interviewer.
4. Result may be affected due to the difference in the mental outlook of interwee and interviewer.
5. One sided and incomplete research.
6. Art rather than science.

2.6.5.4. Observation Schedule

This is most commonly used technique of evaluation research. It is used for evaluating cognitive and non-cognitive aspects of a person. It is used in evaluation performance, interests, attitudes, values towards their life problems and situations. It is most useful technique for evaluating the behaviors of children.

"Observation employs relatively more visual and senses than audio and vocal organs."

C.A. Mourse

- The cause- effect relationship and study of events in original form, is known as observation.
- Observation seeks to ascertain what people think and do by watching them in action as they express themselves in various situations and activities.
- Observation is recognized as the most direct means of studying people when one is interested in their overt behavior.
- In questionnaires and interview people may write answer as they think, they do but this is often different from what they actually do. These restrictions are missing in observation so observation is a more natural way of gathering data. Artificiality and formality of questionnaires and interview is replaced by reality and informality

in observation. Data obtained through observation are more real and true than the data collected by any other method. It also plays a particular part in survey procedure.

Characteristics of Observation Schedule:

According to **Jahoda** it has many characteristics;

1. It serves a formulated research purpose.
2. It is planned systematically rather than occurring haphazardly.
3. It is systematically recorded and related to more general propositions.
4. It is subjected to checks and controls with respect to validity , reliability and precision.
5. It is a direct technique to study an object, an event or a problem.
6. It is based mainly on visual –audio scene.
7. It employs own experiences.
8. It establishes cause-effect relationship.
9. It is an objective technique of data collection.
10. It is both objective and subjective evaluation technique.
11. It is formal as well as informal technique.
12. It is quantitative as well as qualitative technique for data collection.

Advantages:

1. It is reliable and valid technique of collecting data and information.
2. We get first hand data through this method.
3. Record of observation is also available immediately.
4. It is simple, broad and comprehensive method.
5. It is an oldest technique of data collection and getting direct information.

Limitations:

1. It has a limited scope for its use because all the events cannot be observed directly.
2. It is subjective method.
3. It is very time consuming process.
4. Costly so energy consuming also.

5. Presence of observer influences the behavior of the person i.e. subject becomes conscious.
6. In case covert behavior, which can't be observed, it is not useful.
7. Observer should be trained and experienced.

2.6.5.5. Rating Scale

Ratting is term applied to express opinion 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.

"Rating is an essence and direct observation."

Ruth Strong

"A rating scale ascertains the degree, intensity and frequency of a variable."

Von Dallen

- Rating techniques are more commonly used in scaling traits and attributes.
- A rating method is a method by which one systematizes, the expression of opinion concerning a trait.
- The rating is done by parents, teachers, a board of interviewers and judges and even by the self as well.
- The special feature of rating scale is that the attitudes are evaluated not on the basis of the opinions of the subjects but on the basis of the opinions and judgments of the experimenter himself.
- In rating scale data are collected by; Verbal behavior, facial expression, personal documents, clinical type interview, projective techniques and immediate experiences as emotions, thoughts and perceptions.

Advantages:

1. Writing reports to parents.
2. Filling out admission blanks for colleges.
3. Finding out students' needs.
4. Making recommendations to employers.
5. Supplementing other sources of under taking about child.
6. Stimulating effect upon the rates.

Limitations:

1. Difference in rating abilities.
2. Difference in reliability as subjects for rating.
3. Agreement among raters of one type of contact only.
4. Average superior than single.
5. Impact of emotions.
6. Limits of self-rating.
7. Over rating.
8. Limits of rating of specific qualities.
9. Limits of justifications.

2.6.7. Data Collection and Analysis

Activities Involved in Data Collection:

Data must be collected and recorded in a form suitable for the intended analysis. The collection of data requires time and substantial effort for acquiring skills and making the necessary arrangements for collection and to ensure adequate quality.

Access to Data:

Generally it is a problem for researcher to get access to data because the institutions or the persons who generally control the data are not willing to provide him data for one or the other reason or excuse. Some necessary steps are required to motivate such institutions or persons to provide necessary data willingly. Some educational problems are of such nature that the subjects specially girls are not willing to disclose correct information. Similarly a researcher of any board or university may not have access to confidential data.

(ii) Proper attention should be paid to measurement error.

Adequate Standard:

The researcher should demonstrate that his data were properly collected. It is possible if the following conditions are fulfilled.

(i) It should be ensured that the supplied data met e requirement of validity. In other words the data should, ensure what they claimed to measure.

The following types of error are possible in data collection;

(a) Errors due to malfunctioning of measuring equipment/ instrument.

(b) Error of bias.

(c) Deliberate falsehood.

(d) Distortion of facts.

(e) Random errors.

(iii) It should be ensured that a suitable sample was drawn out of the population so that proper generalization could be made.

(iv) It should also be checked that the data were properly recorded. The conditions under which the data were gathered should be properly noted and suitable data recording method should be used. The efforts should be made to detect and eliminate errors arising during recording. The data are generally recorded in the following forms;

(a) notes of the researcher

(b) Log books and journals are used by a researcher doing the experiment or conducting a field study

(c) Interview notes

(d) Responses to questionnaires

(e) Recording on tape recorder.

(f) Video cameras

(g) Transcribing data for computer input

Data Organization:

Whatever method is used for collection of data it will be necessary that an extensive set of supplementary notes should be made for the following;

(a) Sources of data

(b) Conditions under which data were gathered.

There should be stored in such a way as offer some reasonable prospects of retrieval when required.

Collecting Primary Data and Secondary Data:

The primary data can be collected through laboratory measurement, field observation, questionnaires, interviews, opinionnaires, schedules etc.

The secondary data can be collected from technical publications such as manuals, handbooks, data sheets, and standards, books and journals, official publications of the Central government, state governments, local bodies, private data services and computer data base.

Analysis of Data:

Definition of research in data analysis:

According to Le Compte and Schensul, research data analysis is a process used by researchers for reducing data to a story and interpreting it to derive insights. The data analysis process helps in reducing a large chunk of data into smaller fragments, which makes sense.

Three essential things take place during the data analysis process — the first data organization. Summarization and categorization together contribute to becoming the second known method used for data reduction. It helps in finding patterns and themes in the data for easy identification and linking. Third and the last way is data analysis – researchers do it in both top-down or bottom-up fashion.

Marshall and Rossman, on the other hand, describe data analysis as a messy, ambiguous, and time-consuming, but a creative and fascinating process through which a mass of collected data is being brought to order, structure and meaning.

We can say that "the data analysis and interpretation is a process representing the application of deductive and inductive logic to the research and data analysis."

Why analyze data in research?

Researchers rely heavily on data as they have a story to tell or problems to solve. It starts with a question, and data is nothing but an answer to that question. But, what if there is no question to ask? Well! It is possible to explore data even without a problem – we call it 'Data Mining' which often reveal some interesting patterns within the data that are worth exploring.

Irrelevant to the type of data, researchers explore, their mission, and audiences' vision guide them to find the patterns so they could shape the story they want to tell. One of the important things expected from researchers while analyzing data is to stay open and remain unbiased towards unexpected patterns, expressions, and results. Remember, sometimes, data analysis tells the most unforeseen yet exciting stories that were not at all expected at the time of initiating data analysis. Therefore, rely on the data you have at hand and enjoy the journey of exploratory data analysis in research.

Types of data in research

Every kind of data has a rare quality of describing things after assigning a specific value to it. For analysis, you need to organize these values, processed and presented in a given context, to make it useful. Data can be in different forms, here are the primary data types

Qualitative data: When the data presented has words and descriptions, then we call it qualitative data. Although you can observe this data, it is subjective and, therefore, harder to analyze data in research, especially for comparison.

Example: Quality data represents everything describing taste, experience, texture, or an opinion is considered as a quality data. This type of data is usually collected through focus groups, personal interviews, or using open-ended questions in surveys.

Quantitative data: Any data expressed in numbers of numerical figures are called quantitative data. This type of data can be distinguished into categories, grouped, measured, calculated, or ranked. Example: questions such as age, rank, cost, length, weight, scores, etc. everything comes under this type of data. You can present such data in graphical format, charts, or you can apply statistical analysis methods to this data. The (Outcomes Measurement Systems) OMS questionnaires in surveys are a significant source of collecting numeric data.

Categorical data: It is data presented in groups. However, an item included in the categorical data cannot belong to more than one group at a time. Example: a person responding to a survey by telling his living style, marital status, smoking habit, or drinking habit comes under the categorical data. A chi-square test is a standard method used to analyze this data.

Data analysis in qualitative research:

Data analysis and research in qualitative data work a little differently than the numerical data as the quality data is made up of words, descriptions, images, objects, and sometimes symbols. Getting insight from such complicated information is a complicated process, hence is typically used for exploratory research and data analysis.

Finding patterns in the qualitative data

Although there are several ways to find patterns in the textual information, a word-based method is the most relied and widely used global technique for research and data analysis. Notably, the data analysis process in qualitative research is manual. Here the researchers usually read the available data and find repetitive or commonly used words.

For example: while studying data collected from African countries to understand the most pressing issues faced by people, researchers might find ”food” and ”hunger” are the most commonly used words and will highlight them for further analysis

The keyword context is another widely used word-based technique. In this method, the researcher tries to understand the concept by analyzing the context in which the participants use a particular keyword.

For example, researchers conducting research and data analysis for studying the concept of ‘diabetes’ amongst respondents might analyze the context of when and how the respondent has used or referred to the word ‘diabetes.’

Methods used for data analysis in qualitative research

There are several techniques to analyze the data in qualitative research, but here are some commonly used methods,

Content Analysis: It is widely accepted and the most frequently employed technique for data analysis in research methodology. It can be used to analyze the documented information from text, images, and sometimes from the physical items also. It depends on the research questions to predict when and where to use this method.

Narrative Analysis: This is a method used to analyze content gathered from various sources. Here the source can be personal interviews, field observation, and surveys. The majority of times, stories, or opinions shared by people are focused on finding answers to the research questions.

Discourse Analysis: Similar to narrative analysis, discourse analysis is used to analyze the interactions with people. Nevertheless, this particular method takes into consideration the social context under which or within which the communication between the researcher and respondent takes place. In addition to that, discourse analysis also focuses on the lifestyle and day-to-day environment while deriving any conclusion.

Grounded Theory: When you want to explain why a particular phenomenon happened, then using grounded theory for analyzing quality data is the best resort. Grounded theory is applied to study data about the host of similar cases occurring in different settings. When researchers are using this method, they might alter explanations or produce new ones until they arrive at some conclusion.

Data analysis in quantitative research:

Preparing data for analysis:

The first stage in research and data analysis is to make it for the analysis so that the nominal data can be converted into something meaningful. Data preparation consists of four phases

Phase I: Data Validation

Data validation is done to understand if the collected data sample is per the pre-set standards, or it is a biased data sample again divided into four different stages

Fraud: To ensure an actual human being records each response to the survey or the questionnaire

Screening: To ensure each participant or respondent is selected or chosen in compliance with the research criteria

Procedure: To ensure ethical standards were maintained while collecting the data sample

Completeness: To ensure that the respondent has answered all the questions in an online survey. Else, the interviewer had asked all the questions devised in the questionnaire.

Phase II: Data Editing

More often, an extensive research data sample comes loaded with errors. Respondents sometimes fill in some fields incorrectly or sometimes skip them accidentally. Data editing is a process wherein the researchers have to confirm that the provided data is free of such errors. For that, they need to conduct necessary checks and outlier checks to edit the raw edit and make it ready for analysis.

Phase III: Data Coding

Out of all three, this is the most critical phase of data preparation, which is associated with grouping and assigning values to the survey responses. Suppose a survey is completed with a 1000 sample size, then the researcher will create an age bracket to distinguish the respondents based on their age. Thus, it becomes easier to analyze small data buckets rather than to deal with the massive data pile.

Methods used for data analysis in quantitative research:

After the data is prepared for analysis, researchers are open to using different research and data analysis methods to derive meaningful insights. For sure, statistical techniques are most favored to analyze the numerical data. The technique is again classified into two groups. First, 'Descriptive Statistics' used to describe data. Second, 'Inferential statistics' that helps in comparing the data.

Descriptive statistics:

This method is used to describe the basic features of versatile types of data in research. It presents the data in such a meaningful way that pattern in the data starts making sense. Nevertheless, the descriptive analysis does not go beyond making conclusions.

The conclusions are again based on the hypothesis researchers have formulated so far. Here are a few major types of descriptive analysis methods

Measures of Frequency

- Count, Percent, Frequency
- It is used to denote home often a particular event occurs
- Researchers use it when they want to showcase how often a response is given

Measures of Central Tendency

- Mean, Median, Mode
- The method is widely used to demonstrate distribution by various points
- Researchers use this method when they want to showcase the most commonly or averagely indicated response

Measures of Dispersion or Variation

- Range, Variance, Standard deviation
- Here the field equals to high/low points
- Variance standard deviation = difference between the observed score and mean
- It is used to identify the spread of scores by stating intervals
- Researchers use this method to showcase data spread out. It helps them identify the depth until which the data is spread out that it directly affects the mean.

Measures of Position:

- Percentile ranks, Quartile ranks
- It relies on standardized scores helping researchers to identify the relationship between different scores.
- It is often used when researchers want to compare scores with the average count.

For quantitative market research use of descriptive analysis often give absolute numbers, but the analysis is never sufficient to demonstrate the rationale behind those numbers. Nevertheless, it is necessary to think of the best method to be used for research and data analysis suiting your survey questionnaire and what story researchers want to tell. For example, the mean is the best way to demonstrate the average scores of the students in schools. It is better to rely on the descriptive statistics when the researchers intend to keep the research or outcome limited to the provided sample without generalizing it to

the population. For example, when you want to compare average voting done in two different cities, then differential statistics is enough.

Descriptive analysis is also called a 'univariate analysis' since it is commonly used to analyze a single variable.

Inferential statistics:

Inferential statistics are used to make predictions about a larger population after research and data analysis of the collected sample of the representing population. For example, at a movie theater, you can ask some odd 100 audiences if they like the movie they are watching. Researchers then use inferential statistics on the collected sample to reason that about 80-90% of people like the movie they are watching.

Here are two significant areas of inferential statistics

- **Estimating parameters:** it takes statistics from the sample research data and uses it to demonstrate something about the population parameter.
- **Hypothesis test:** it's about sampling research data to answer the survey research questions. For example, researchers might be interested to understand if the new shade of lipstick recently launched is good or not, or if the multivitamin capsules help children to perform better at games.

These are sophisticated analysis methods used to showcase the relationship between different variables instead of describing a single variable. It is often used when researchers want something beyond absolute numbers to understand the relationship between variables.

Here are some of the commonly used methods for data analysis in research

Correlation: When researchers are not conducting experimental research wherein the researchers are interested to understand the relationship between two or more variables, they opt for correlational research methods.

Cross-tabulation: Also called as contingency tables, cross-tabulation is a method used to analyze the relationship between multiple variables. Suppose a provided data has age and gender categories presented in rows and columns, then a two-dimensional cross-tabulation helps for seamless data analysis and research by showing the number of males and the number of females in each age category.

Regression analysis:

For understanding the strong relationship between two variables, researchers do not look beyond the primary and commonly used regression analysis method, which is also

a type of predictive analysis used. In this method, you have an essential factor called the dependent variable, and you also have multiple independent variables in regression analysis, you undertake efforts to find out the impact of independent variables on the dependent variable. The values of both independent and dependent variables are assumed as being ascertained in an error-free random manner.

Frequency tables: The statistical procedure is used for testing the degree to which two or more vary or differ in an experiment. A considerable degree of variation means research findings were significant. In many contexts, ANOVA testing and variance analysis are similar.

Analysis of variance: The statistical procedure is used for testing the degree to which two or more vary or differ in an experiment. A considerable degree of variation means research findings were significant. In many contexts, ANOVA testing and variance analysis are similar.

Considerations in research data analysis:

- Researchers must have the necessary skills to analyze the data, Getting trained to demonstrate a high standard of research practice. Ideally, researchers must possess more than a basic understanding of the rationale of selecting one statistical method over the other to obtain better data insights.
- Usually, research and data analytics methods differ by scientific discipline; therefore, obtaining statistical advice at the beginning of analysis helps in designing a survey questionnaire, selecting data collection methods, selecting samples.
- The primary aim of data research and analysis is to derive ultimate insights that are unbiased. Any mistake in or keeping a biased mind to collect data, selecting analysis method, or in choosing audience sample il to result in drawing a biased inference.
- Irrelevant to the sophistication used in research data and analysis is enough to rectify the poorly defined objective outcome measurements. It does not matter if the design is at fault or intentions are not clear, but lack of clarity might mislead readers, therefore avoid the practice.
- The motive behind data analysis in research is to present accurate and reliable data. As far as possible, avoid statistical errors, and find a way to deal with everyday challenges like outliers, missing data, data altering, data mining, or developing graphical representation.

2.7 Standardization of Research Instruments:

Standardization refers to methods used in gathering and treating subjects for a specific study. In order to compare the results of one group to the results of a second group, we must assure that each group receives the same opportunities to succeed. Standardized tests, for instance, painstakingly assure that each student receives the same questions in the same order and is given the same amount of time, the same resources, and the same type of testing environment. Without standardization, we could never adequately compare groups.

For example, imagine that one group of students was given a particular test and allowed four hours to complete it in a quiet and well lit room. A second group was given the same test but only allowed 30 minutes to complete it while sitting in a busy school lunchroom full of laughing and talking children. If group 1 scored higher than group 2 could we truly say that they did better? The answer is obviously 'no.' to make sure we can compare results, we must make everything equal between the two or more groups. Only then could we say that group 1 performed better than group 2.

2.7.1. Selection of Items:

Selection items (or selected response items) are test items on which the examinee selects one of a set of choices, rather than generating an original response. A test item is a specific task test takers are asked to perform. Test items can assess one or more points or objectives, and the actual item itself may take on a different constellation depending on the context. ... For example, there could be five items all testing one grammatical point.

The usual procedure in objective test construction is to prepare a larger pool of test items than will be used in the final form of the instrument. When the test is designed to rank subjects on some specified characteristics, item discriminating power is often used as the criterion for selection of items.

2.7.2. Validity

Validity refers to the appropriate or accuracy or truthfulness interpretations made from test scores and other evaluates with regard to particular usage. e.g., if a test is to be conducted to describe pupil's achievement, one should be able to interpret the scores as a relevant sample of the achievement to be measured. Basically validity is concerned with the specific use of the results and the sound interpretations based on definite premises. Are we measuring what we think we are? This is a simple concept, but in reality, it is extremely difficult to determine if a measure is valid.

Content validity is similar to face validity in that it relies on the judgment of the researcher. However, where face validity only evaluates the individual items on an instrument, content validity goes further in that it attempts to determine if an instrument provides adequate coverage of a topic. Expert opinions, literature searches, and open-ended pre-test questions help to establish content validity.

Criterion-related validity can be either predictive or concurrent. When a dependent / independent relationship has been established between two or more variables, criterion-related validity can be assessed. A mathematical model is developed to be able to predict the dependent variable from the independent variable.

Predictive validity refers to the ability of an independent variable (or group of variables) to predict a future value of the dependent variable.

Concurrent validity is concerned with the relationship between two or more variables at the same point in time.

Construct validity refers to the theoretical foundations underlying a particular scale or measurement. It looks at the underlying theories or constructs that explain phenomena. This is also quite subjective and depends heavily on the understanding, opinions, and biases of the researcher.

Face validity is based solely on the judgment of the researcher. Each question is scrutinized and modified until the researcher is satisfied that it is an accurate measure of the desired construct. The determination of face validity is based on the subjective opinion of the researcher.

2.7.3. Reliability

Reliability is synonymous with repeatability. A measurement that yields consistent results over time is said to be reliable. Whenever anything is measured, whether in the physical, biological, or behavioral sciences, there is some possibility of chance error or measurement error. This is true for educational or psychological tests as well.

According to **Anastasi (1968)** "Reliability means consistency of scores obtained by same individual when re-examined the test on different sets of equivalent items or under other variable examining conditions."

Characteristics of reliability:

- It is consistency of a test scores.
- It is the measure of variable error or chance error or measurement error.

- It is refers to the stability of a certain population.
- It is the coefficient of stability.
- It is the reproducibility of the scores.

There are three basic methods to test reliability: **test-retest, Parallel-Forms Reliability, and internal consistency, split-half reliability.**

Test-Retest Reliability

We estimate test-retest reliability when we administer the same test to the same sample on two different occasions. This approach assumes that there is no substantial change in the construct being measured between the two occasions. The amount of time allowed between measures is critical. We know that if we measure the same thing twice that the correlation between the two observations will depend in part by how much time elapses between the two measurement occasions. The shorter the time gap, the higher the correlation; the longer the time gap, the lower the correlation. This is because the two observations are related over time — the closer in time we get the more similar the factors that contribute to error. Since this correlation is the test-retest estimate of reliability, you can obtain considerably different estimates depending on the interval.

Parallel-Forms Reliability:

In parallel forms reliability you first have to create two parallel forms. One way to accomplish this is to create a large set of questions that address the same construct and then randomly divide the questions into two sets. You administer both instruments to the same sample of people. The correlation between the two parallel forms is the estimate of reliability. One major problem with this approach is that you have to be able to generate lots of items that reflect the same construct. This is often no easy feat. Furthermore, this approach makes the assumption that the randomly divided halves are parallel or equivalent. Even by chance this will sometimes not be the case. The parallel forms approach is very similar to the split-half reliability described below. The major difference is that parallel forms are constructed so that the two forms can be used independent of each other and considered equivalent measures. For instance, we might be concerned about a testing threat to internal validity. If we use Form A for the pretest and Form B for the posttest, we minimize that problem. it would even be better if we randomly assign individuals to receive Form A or B on the pretest and then switch them on the posttest. With split-half reliability we have an instrument that we wish to use as a single measurement instrument and only develop randomly split halves for purposes of estimating reliability.

Internal Consistency Reliability:

In internal consistency reliability estimation we use our single measurement instrument administered to a group of people on one occasion to estimate reliability. In effect we judge the reliability of the instrument by estimating how well the items that reflect the same construct yield similar results. We are looking at how consistent the results are for different items for the same construct within the measure. There are a wide variety of internal consistency measures that can be used.

Split-half reliability:

In split-half reliability we randomly divide all items that purport to measure the same construct into two sets. We administer the entire instrument to a sample of people and calculate the total score for each randomly divided half. the split-half reliability estimate, as shown in the figure, is simply the correlation between these two total scores.

Cronbach's Alpha (a) Reliability:

Imagine that we compute one split-half reliability and then randomly divide the items into another set of split halves and recompute, and keep doing this until we have computed all possible split half estimates of reliability. Cronbach's Alpha is mathematically equivalent to the average of all possible split-half estimates, although that's not how we compute it. Notice that when I say we compute all possible split-half estimates, I don't mean that each time we go an measure a new sample! That would take forever. Instead, we calculate all split-half estimates from the same sample. Because we measured all of our sample on each of the six items, all we have to do is have the computer analysis do the random subsets of items and compute the resulting correlations. The figure shows several of the split-half estimates for our six item example and lists them as SH with a subscript. Just keep in mind that although Cronbach's Alpha is equivalent to the average of all possible split half correlations we would never actually calculate it that way.

2.7.4. Norms:

Test norms consist of data that make it possible to determine the relative standing of an individual who has taken a test. By itself, a subject's raw score (*e.g.,* the number of answers that agree with the scoring key) has little meaning. Almost always, a test score must be interpreted as indicating the subject's position relative to others in some group. Norms provide a basis for comparing the individual with a group.

Numerical values called centiles (or percentiles) serve as the basis for one widely applicable system of norms. From a distribution of a group's raw scores the percentage of subjects falling below any given raw score can be found. Any raw score can then be

interpreted relative to the performance of the reference (or normative) group—eighth-graders, five-year-olds, institutional inmates, job applicants. The centile rank corresponding to each raw score, therefore, shows the percentage of subjects who scored below that point. Thus, 25 percent of the normative group earn scores lower than the 25th centile; and an average called the median corresponds to the 50th centile.

2.8. Let us sum up:

- It is clear from the objective of the education research the classification of educational research can be through various types. The standard of main classification is from the angle of participation, from the angle of accuracy of research result. In this unit the types of research has been discussed on the basis of various dimensions. Few types of research have been discussed in details such as qualitative, quantitative, fundamental, applied and action research.
- Along with the types research methods are also important. In this unit, different types of research method have been discussed such as descriptive, co-relational, ex-post facto and experimental design. Descriptive method of research deals with the prevailing problem. Research is basic to every field of knowledge. It is a tool of tremendous importance for verifying, testing and validating current and old knowledge and also a potent means of creating new knowledge. Descriptive research means an investigation, which focuses on just describing the phenomenon telling, as an outcome of research, Like other types of research, descriptive research also follows such steps as (1) identifying and defining the problem, (2) stating objectives and hypotheses, (3) collecting relevant data, both qualitative and quantitative, (4) analysing data and (5) drawing inferences and conclusions Whereas Correlational research is a type of non-experimental research method, in which a researcher measures two variables, understands and assess the statistical relationship between them with no influence from any extraneous variable. An ex post facto research design is a method in which groups with qualities that already exist are compared on some dependent variable. Experimental design refers to how participants are allocated to the different conditions in an experiment. There are three types: Independent measures / between groups: Different participants are used in each condition of the independent variable.
- Variable is very important aspect of educational research. There are mainly three types of research such as independent, dependent and extraneous variable have been discussed in this unit.

- The main work of education research is to improve and develop the process of educational research. In the process of research, selection of research problem is very important because research begins with a specific problem. After the selection of the problem, by review of related literature, researcher understands research process through which he comes to knows how the study is to be done. In the main sources of information, author directs his work, by thesis, books, one subject essay, and dissertations or by medium of thesis applies such a sources gives more information than available sources of information. After the detailed survey of related literature, the next step of researcher is to collect appropriate information systematically. Along with the research problem review literature, sampling, hypothesis and instruments of data collection such as test, questionnaire, interview, rating scale have been discussed in this unit.
- Data collection is gathering of information from various sources, and data analytics is to process them for getting useful insights from it. ... For data collected from different sources and methods need specific data analysis methods and tools to process and get insights from them.
- Standardization. Standardization refers to methods used in gathering and treating subjects for a specific study. In order to compare the results of one group to the results of a second group, we must assure that each group receives the same opportunities to succeed.

2.9. Unit end exercises

1. What do you mean by educational research?
2. Illustrate necessity of educational research in education field.
3. Describe the area of educational research.
4. Write notes on "future needs of research."
5. What do you understand by selection of research problem?
6. Evaluate the selected problems.
7. Write notes on problem statement.
8. What do you mean by problem analysis and their definition?
9. What do you mean by descriptive research?
10. Describe the types of descriptive research.

11. What do you mean by survey research?
12. Write down different types of survey research.
13. Describe the methodology of survey research
14. Write down the different steps taken in survey research.
15. What do you mean by review related literature and hypothesis? Explain.
16. Describe useful reference material in research for researcher (collected book).
17. Explain research thesis.
18. Describe briefly the management of related literature.
19. What is the basic purpose of correlational studies? How does correlational research determine the relations between two or more variables?
20. What is correlational coefficient? What does the bigger value it shows?
21. Briefly explain the various quantitative research methods.
22. What does the basic purpose of statistical methods in correlation studies?

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Unit : 3 ◘ Methods of Quantitative Analysis

Structure:

3.1 Introduction:

In psychology and Education data are collected through measurement. These data are arranged in meaningful way. After that they are analysed properly using many statistical techniques to find out the results and to draw conclusion from it. There are mainly two types of statistics used in research which are descriptive statistics and inferential statistics. Descriptive statistical measures are used to describe the characteristics of the sample or population in totality. They limit generalisation to the particular group or individuals. No conclusions are extended beyond this group. The measures of descriptive statistics most commonly used in educational research are measures of central tendency, measures of dispersion, measures of relationship etc. In inferential statistics the researcher enables to make generalisations or inferences about populations from the observations of the characteristics of samples. In this unit we will discuss different types of descriptive statistics and inferential statistics used in educational research. Here it is also discussed that how the data are arranged in tables and can be represented graphically.

3.2 Objectives:

After completion the unit the learner will be able to –

- Discuss the concept of parametric and non parametric tests.
- Enumerate the concept of descriptive statistics.
- Explain the applications of different inferential statistics.
- Elucidate the application of computer in statistics.
- Discuss tabulation and graphical representation of data.

3.3 Parametric and Non-Parametric tests

In Education and psychology or other behavioural researches parametric and non-parametric tests are used very frequently. Parametric tests are more powerful than non-parametric tests because a parametric test specifies certain conditions about the parameter of the population from which the sample is drawn, whereas a non-parametric test does not specify any condition about the parameter of the population from which the sample is taken. There are certain basic assumptions which should be fulfilled for the use of parametric test. These assumptions are given below:

i) The observations must be independent and be drawn from a population which is normally distributed.
ii) The samples which are taken from a normally distributed population must have equal or nearly equal variances.
iii) The variables must be expressed in ratio or interval scales; not in nominal or ordinal scales.

t-test, z test, F test etc are the examples of parametric test. These tests will be discussed later.

Non-parametric tests are distribution-free statistics because these tests do not specify any rigid condition or assumption about the form of distribution of the population. A non-parametric test is less precise because it is based on ranking or frequency counts. When the assumptions for parametric tests are not fulfilled then only non-parametric tests are used. The conditions of non-parametric tests are given below:

i) The population from which the samples are taken is not known to be normally distributed.
ii) The variables are expressed in nominal scale or in ordinal scale.

There are many non-parametric tests but chi square test and Mann-Whitney test are very commonly used non-parametric tests. These tests will be discussed in details later.

3.4 Descriptive Statistics

3.4.1 Measures of Central Tendency

Measures of central tendency is also known as statistical average. It tells upon the point about which items have a tendency to cluster. It is also considered as the most representative figure for the entire mass of data. Mean, Median and Mode are the most common measures of central tendencies.

MEAN

Mean is the average of the scores under study. It is also known as arithmetic mean. A simple example of mean is like this:

In a class, the marks in mathematics of five students are 35, 68, 85, 32 and 50. Then the average mark obtained by the students is (35+68+85+32+50)/5 = 54.

So, Mean = (Sum of all scores)/ (No. of scores).

If $x_1, x_2, x_3, x_4, \ldots\ldots\ldots\ldots x_N$ are the values of N items, then their mean (M) is given by the following formula:

$$M = (x_1, x_2, x_3, x_4, \ldots\ldots\ldots\ldots x_N) / N = \sum x / N$$

The above formula is used for calculation of mean in the case of ungrouped data.

Calculation of Mean for grouped data:

a) General Method:

Mean for the grouped data can be calculated with the help of following formula

$$M = \sum(fx) / N$$

Where X is the mid-point of the class interval , f its respective frequency and N is the total of all frequencies.

The use of this formula can be easily understood by taking the following example.

Example:

Scores	f	Mid-point (X)	fX
70-74	2	72	144
65-69	4	67	268
60-64	5	62	310
55-59	6	57	342
50-54	7	52	364
45-49	11	47	517
40-44	9	42	378
35-39	3	37	111
30-34	2	32	64
25-29	1	27	27

N = 50 $\sum fx = 2525$

$M = \sum(fx)/ N = 2525/ 50 = 50.5$

b) Short Cut Method

There is a short-cut method for calculation of mean for the grouped data. The formula used for this method is given below :

$$M = A + \frac{\sum fx'}{N} \times i$$

Where, A = Assumed Mean

f = Respective frequency of the mid-values of the class intervals

N = Total frequency

i = Class interval

and $x' = \frac{X - A}{i}$ (as discussed earlier, X is the mid-value of the class)

The short-cut method can be easily explained by taking the following frequency distribution.

Example :

Scores	f	**X** (Mid Point)	**A** (Assumed Mean)	$x' = (X - A)/i$	fx'
70-74	2	72		+5	10
65-69	4	67		+4	16
60-64	5	62		+3	15
55-59	6	57		+2	12
50-54	7	52		+1	7

45-49	11	47	47	0	0
40-44	9	42		–1	–9
35-39	3	37		–2	–6
30-34	2	32		–3	–6
25-29	1	27		–4	–4
	N = 50				$\Sigma fx^1 = 35$

Here, A = 47

N = 50

i = 5

$\Sigma fx' = 35$

$$\therefore \text{Mean, } M = A + \frac{\sum fx'}{N} \times i$$

$$= 47 + \frac{35}{50} \times 5 = 47 + 3.5 = 50.5$$

Here it is to be noted that the mean of the same frequency distribution is calculated using two methods separately. But the result is same.

Characteristics of Mean : (i) Mean is computed on the basis of all observations. (ii) It is highly affected by the extreme values. (iii) Its value is always definite for a given distribution.

Median:

Median is the measure or value of the middle point of a distribution of scores when the distribution is arranged in ascending or descending order. So, it can be said that median of a distribution is the point on the score below which 50% of the scores fall. In other words, median is the value of that central item which divides the series into two equal parts.

Calculation of Median

a. For ungrouped data

For ungrouped data, two cases may arise :

(i) When no. of items in a series (N) is odd :

In this case, the median is the value of $\frac{N+1}{2}$th item.

Example :

Let the scroes of 9 students in English be 28, 25, 46, 43, 56, 60, 37, 15, 52. To find out the median of these scroes, we have to arrange the scores in ascending or descending order. If we arrange the scroes inascending order then the series becomes :

15, 25, 28, 37, 43, 46, 52, 56, 60

Here N = 9 $\quad\quad \therefore \frac{N+1}{2} = \frac{9+1}{2} = 5$

So, the median will be the 5th item of the series = 43

(ii) When no. of items in a series (N) is even :

In this case median is calculated by the following formula.

$$\text{Median} = \frac{\text{Value of } \frac{N}{2}\text{th item} + \text{value of } \left(\frac{N}{2}+1\right)\text{th item}}{2}$$

Example :

Let the scores of 10 students in History be 65, 30, 40, 25, 50, 48, 56, 35, 60, 49.

If we arrange this series in ascending order, then the series becomes :

25, 30, 35, 40, 48, 49, 50, 56, 60, 65.

Here N = 10

$\therefore$ $\frac{N}{2}$th i.e. 5th item is 48 and $\left(\frac{N}{2}+1\right)$th i.e. 6th item is 49.

So, Median = $\frac{48+49}{2}$ = 48.5

b. Meidan for grouped data :

If the data are available in the form of continuous frequency distribution, then

we have to locate the class in which $\frac{N}{2}$th (Where N = total frequency) cumulative frequency lies. This class is known as median class. After locating the median class, the median of the distribution may be calculated with the help of following formula :

$$\text{Median} = L + \left[\frac{\frac{N}{2} - F}{f}\right] \times i$$

where L = Exact lower limit of the median class.
F = Total of all frequencies before the median class.
f = frequency of the median class.
i = Class interval.
N = Total of all the frequencies.

The application of the above formula for calculating the median of grouped data can be easily understood by the following example.

Examples :

Scores	f	**Cumulative freq. (*cf*)**	
70-74	2	50	
65-69	4	48	
60-64	5	44	
55-59	6	39	
50-54	7	33	
45-49	11	26	→ Median class
40-44	9	15	
35-39	3	6	
30-34	2	3	
25-29	1	1	

N = 50

Calculation of the Median :

Here N = 50

$$\therefore \frac{N}{2} = \frac{50}{2} = 25$$

So, from the table it is seen that the class interval designated as 45–49 is to be labelled as median class.

Now, L = 44.5 (exact lower limit of the median class)

F = 15

f = 11

i = 5

$$\therefore \text{Median} = L + \left(\frac{\frac{N}{2} - F}{f}\right) \times i \qquad = 44.5 + \left(\frac{\frac{50}{2} - 15}{11}\right) \times 5$$

$$= 44.5 + \frac{10}{11} \times 5 = 44.5 + 4.55 = 49.05$$

Characteristics of Median :

(i) The computation of median is not based on all the observations.

(ii) Median is not affected by the extreme values.

(iii) It indicates the value of the middle item in the distribution.

Mode:

Mode is defined as the score which occurs most frequently in a distribution. In other words, mode is the point on the score scale that corresponds to the maximum frequency of the distribution.

a. Mode for ungrouped data :

To find out the mode for ungrouped data one has to find out the score which is repeated maximum number of times.

Examples :

Let, the score of an achievement test of 10 students are as follows :

30, 35,25, 40, 35, 45, 40, 35, 28, 34.

Here, the score 35 is repeated maximum number of times. So, the value of the mode of the above distribution is 35.

b. Mode for grouped data :

For grouped data, mode can be calculated by using the following formula :

$$\text{Mode} = \text{L} + \frac{f_S}{f_P + f_S} \times i$$

Where, L = lower limit of the modal class [Modal class is the class in which mode maybe supposed to lie]

f_S = frequency of the class succeeding the modal class.

f_P = frequency of the class preceding the modal class

i = class interval.

Let us illustrate the use of this formula by taking the frequency distribution as given below :

Examples :

Scores	f	
70-74	2	
65-69	4	
60-64	5	
55-59	6	
50-54	7	
45-49	11	→ modal class
40-44	9	
35-39	3	
30-34	2	
25-29	1	

N = 50

If we look at the frequency distribution, the crude mode may be supposed to lie within the class interval 45–49. Hence, the modal class is 45–49.

Now, $L = 44.5$

$f_S = 7$

$f_P = 9$

$i = 5$

$\therefore$ Mode $= L + \frac{f_S}{f_P + f_S} \times i = 44.5 + \frac{7}{9+7} \times 5 = 44.5 + \frac{7}{16} \times 5 = 44.5 + 2.19 = 46.09$

C. Crude Mode for grouped data :

For grouped data, mode can be calculated indirectly with the help of following formula :

Mode = 3 × Median – 2 × Mean

If we calculate the mean & median of a given frequency distribution, then the crude mode can easily be estimated using the above formula.

Example :

We have calculated the mean and median of the same frequency distribution as discussed earlier.

It is found that, Mean = 50.5

Median = 49.05

$\therefore$ Mode = 3 × 49.05 – 2 × 50.5 = 147.15 – 101 = 46.15

Characteristics of Mode :

(i) Mode is not well defined.

(ii) It is not unduly affected by the extreme values.

(iii) Its computation is not based on all the variates.

(iv) It maybe unrepresentative in many cases.

3.4.2 Correlation

In education and Psychology, many situations arise that involve two or more variables. In case the change in one variable appears to be accompanied by a change in other variable, the two variables are said to be correlated and this inter-dependence is called correlation.

There are many types of correlation, like linear, biserial, partial or multiple corrleation.Here our aim is to provide an elementary knowldege of statistical methods. So, we confine ourselves here, to the method of linear correlation. When the relationship between two sets of scores or variables can be represented graphically by a straight line, it is known as linerar correlation. If there is an increase (or decrease) in one variable and this leads to an inrease (or decrease) in another variable, it is known as ***Positive Correlation***.

For example, increase in age of a child leads to increase of his weight. Here age and height have positive correlation.

In there is an increase (or decrease) in one variable and this leads to a decrease (or increase) in another, it is known as ***Negative Correlation.***

For example, more intelligent children take lesser time to solve a problem. Here intelligence and time required have negative correlation.

The third type of correlation is zero correlation. If there exists no relationships between two variables, then it is known as ***Zero Correlation***.

● **Coefficient of Correlation :**

Coefficient of correlation is a statistical measure of the degree to which changes to the value of one variable predict change to the value of another. It is used to express the degree of relationship quatitatively between two sets of measure or variables. The value of coefficient of correlation ranges from + 1.0 to –1.0. When the value of this coefficient is close to +1.0 then the two variables have a very strong

positive correlation and if the value is close to –1.0 then they have a very strong negative correlation. If the value of this coefficient in zero, then the two variables have zero correlation.

Computation of Coefficient of Correlation :

For computing the coefficient of linear correlation, we generally use two different methods :

(i) Rank Difference Method. (ii) Product Moment Method.

Product Moment Method :

It is another method to find out the correlation coefficiet. The coefficient of correlation computed by this method is known as the product moment coefficient of correlation or Pearson's Correlation Coefficient (Υ).

The formula used in the computation of this coefficient of correlation is

$$\Upsilon = \frac{\Sigma xy}{N\sigma_x\sigma_y}$$

Where x = deviation of any X-score from the mean in test X

y = deviation of the corresponding Y score from the mean in test Y

Σxy = Sum of all the products of deviation

σ_x = standard deviation of the distribution of scores in test X

σ_y = Standard deviation of the distribution of scores in test Y

N = Total no. of scores.

● Computation of *r* from ungrouped data :

Case I : When deviations are taken from the mean of the scores :

We know $\Upsilon = \frac{\Sigma xy}{N\sigma_x\sigma_y}$

Now, $\sigma_x = \sqrt{\frac{\Sigma x^2}{N}}$ and $\sigma_y = \sqrt{\frac{\Sigma y^2}{N}}$

$$\therefore \Upsilon = \frac{\Sigma xy}{N \times \sqrt{\frac{\Sigma x^2}{N}} \times \sqrt{\frac{\Sigma y^2}{N}}} = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}}$$

The use of the above formula may be illustrated through the following example :

Example :

Students	Scores in test X	Scores in test Y	Mean of X (M_x)	Mean of (M_y)Y	x	y	xy	x^2	y^2
A	20	26			0	2	0	0	4
B	25	20			5	–4	–20	25	16
C	15	24	20	24	–5	0	0	25	0
D	22	30			2	6	12	4	36
E	28	26			8	2	16	64	4
F	10	18			–10	–6	60	100	36

Here, $x = X - M_x$ $\Sigma xy = 68 \Sigma x^2 = 218$

and $y = Y - M_y$ $\Sigma y^2 = 96$

$$\text{Now, } \Upsilon = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{68}{\sqrt{218 \times 96}} = \frac{68}{144.67} = 0.47$$

Case II. Computation of ϒ directly from raw scores when deviations are taken from zero :

The product moment coeff.of correlation (ϒ) can be calculated directly from raw scores without calculating deviation from the means.

The formula used in this case is

$$\Upsilon = \frac{N\Sigma xy - \Sigma x \Sigma y}{\sqrt{\left[N\Sigma x^2 - (\Sigma x)^2\right]\left[N\Sigma y^2 - (\Sigma y)^2\right]}}$$

Where, X and Y = Raw scroes in the test X and Y respectively.

Σxy = Sum of the products of each X score multiplied with its corresponding Y scroes.

N = total no.of cases or scroes.

The use of this formula may be illustrated transfer the following example.

Example :

Students	Scores in test X	Scores in test Y	XY	X^2	Y^2
A	2	10	20	4	100
B	4	11	44	16	121
C	3	9	27	9	81
D	6	12	72	36	144
E	8	15	120	64	225
N = 5	$\Sigma X = 23$	$\Sigma Y = 57$	$\Sigma XY = 283$	$\Sigma X^2 = 129$	$\Sigma Y^2 = 671$

$$\text{Now, } r = \frac{N\Sigma xy - \Sigma x \Sigma y}{\sqrt{\left[N\Sigma x^2 - (\Sigma x)^2\right]\left[N\Sigma y^2 - (\Sigma y)^2\right]}}$$

$$= \frac{5\times 283 - 23\times 57}{\sqrt{\left[5\times 129 - 23^2\right]\left[5\times 671 - 57^2\right]}}$$

$$= \frac{1415 - 1311}{\sqrt{(649-529)(3355-3249)}} = \frac{104}{\sqrt{120\times 106}} = \frac{104}{112.78} = 0.92$$

The Biserial Correlation:

We have already discussed about Pearson correlation coefficient 'r'. We can calculate 'r' when both the variables are continuous , they are related linearly and the distribution is fairly symmetrical. But when these conditions are not fulfilled we have to choose other special methods of computing correlations such as biserial correlation, point biserial correlation, phi correlation etc. Now we will discuss these methods in details.

In the calculation of 'r' we see that both the variables are continuous. But in behavioural researches we often face situations where both the variables are continuously measureable but one variable is either artificial or natural dichotomous (dichotomous means cut into two parts or divided into two categories). To compute correlation between a continuous variable and a variable reduced to artificial dichotomy we always compute coefficient of biserial correlation; and to compute correlation between a continuous variable and a variable which is naturally dichotomous the we compute coefficient of point biserial correlation.

Now we should know the distinction between artificial and natural dichotomy. In the measurement of one variable, when it is reduced to two categories according to our convenience i.e. the crucial or dividing point is not natural , then it is artificial dichotomy. Some examples of artificial dichotomy can be given as: Pass and fail, Poor and not poor, Radical and conservative etc. From these examples we can see that the division of one

variable into two categories has no clear-cut crucial point or criteria. We choose the dividing point according to our convenience. But when the division of a variable into two categories is quite clear, natural or genuine then it is natural dichotomy. Some examples of natural dichotomy are: Male and female, Living and dead, Having M.Sc. degree or not having M.Sc. degree etc.

Computation of Biserial coefficient of correlation:

The general formula for computation of biserial coefficient of correlation (r_{bis}) is given below:

$$r_{bis} = (M_p - M_q)/ \sigma_t \text{ X } (pq/y)$$

where, M_p is the mean values of the higher group,

M_q is the mean values of the lower group,

σ_t is the standard deviation of the entire group,

p is the proportion of cases in the higher group,

q is the proportion of cases in the lower group (q = 1-p)

and y is the height of the ordinate of the normal curve separating the portion p and q.

The use of the above formula for the calculation of r_{bis} will be clear from the example given below:

Example: The distribution of scores on an achievement test earned by two groups of students those who passed and those who failed in a test of English is given below. Compute the coefficient of biserial correlation.

Scores on an achievement test	Passed in English test	Failed in English test
190-199	10	0
180-189	20	0
170-179	12	7
160-169	40	17
150-159	25	42
140-149	16	28
130-139	12	14
120-129	5	6
110-119	0	0
	140	120

Solution: Here total no. of students N = 140 + 120 = 260

So, p = 140/260 = 0.54

q = 1-0.54 = 0.46

y = Height of the normal curve ordinate separating the portions p and q

= 0.3969 (as obtained from the corresponding Table given in the Appendix)

Now we can easily find out M_p, M_q and σ_t as discussed in details in the previous sections.

Scores on an achievement test	Passed in English test	Failed in English test	Total	Higher group x'	f x'	Lower group y'	fy'	Entire group z'	fz'	fz'^2
190-199	10	0	10	4	40	4	0	4	40	160
180-189	20	0	20	3	60	3	0	3	60	180
170-179	12	7	19	2	24	2	14	2	38	76
160-169	40	17	57	1	40	1	17	1	57	57
150-159	25	42	67	0	0	0	0	0	0	0
140-149	16	28	44	-1	-16	-1	-28	-1	-44	44
130-139	12	14	26	-2	-24	-2	-28	-2	-52	104
120-129	5	6	11	-3	-15	-3	-18	-3	-33	99
110-119	0	6	6	-4	0	-4	-24	-4	-24	96
	N_1 =140	N_2 = 120	N= 260		∑f x'= 109		∑ fy'= -67		∑ fz' = 42	∑ fz'^2= 816

Here, Assumed mean (A) = (150+159)/2 = 154.5

So, $M_p = A + [\sum(fx') / N_1] \times i = 154.5 + (109/140) \times 10 = 154.5 + 7.78 = 162.28$

$M_q = A + [\sum(fy') / N_2] \times i = 154.5 + (-67/120) \times 10 = 154.5 - 5.58 = 148.92$

$\sigma_t = i \times \sqrt{[\sum fz'^2/N - (\sum fz'/N)^2]} = 10 \times \sqrt{[816/260 - (42/260)^2} = 10 \times \sqrt{(3.318 - 0.026)}$

$= 10 \times 1.814 = 18.14$

Therefore, $r_{bis} = (M_p - M_q)/\sigma_t \times (pq/y) = (162.28 - 148.92)/18.14 \times (0.54 \times 0.46/0.3969)$

$= 13.36/18.14 \times 0.6258 = 0.7365 \times 0.6258$

$= 0.46$

Hence, coefficient of biserial correlation = 0.46

Alternative formula for r_{bis} :

$r_{bis} = (M_p - M_t)/ \sigma_t X (p/y)$; where M_t is the mean of the entire group.

We can check the value of r_{bis} of the above problem using this alternative formula.

The Point Biserial Correlation

We have already discussed that we compute point biserial coefficient ($r_{p,bis}$) to find out the relationship between two variables when one variable is a continuous and the other is a natural or genuine dichotomous. It is also discussed that how natural or genuine dichotomy is different from artificial dichotomy.

The formula used for the computation of point biserial coefficient is given below:

$$r_{p,bis} = (M_p - M_q)/ \sigma_t X\sqrt{(pq)}$$

where M_p is the mean values of the higher group,

M_q is the mean values of the lower group,

σ_t is the standard deviation of the entire group,

p is the proportion of cases in the higher group of dichotomous variable

q is the proportion of cases in the lower group (q = 1-p)

There is an alternative formula of calculating coefficient of point biserial:

$$r_{p,bis} = (M_p - M_t)/ \sigma_t X\sqrt{(p/q)}$$

where M_t is the mean of the entire group.

We can have clear idea of the use of the above formula from the example given below:

Example: A group of individuals were asked to answer 'yes' or 'no' for a particular item. Compute the necessary correlation coefficient between the item and total score on an opinion scale from the data given in the following table.

Total Scores on the opinion scale	Yes	No
190-199	10	0
180-189	20	0
170-179	12	7
160-169	40	17
150-159	25	42
140-149	16	28
130-139	12	14
120-129	5	6
110-119	0	6
	140	120

Solution: Here we have two variables, one of which is in continuous state and the other in a genuine dichotomy. So, we have to compute point biserial correlation coefficient to solve the problem.

Here total no. of individuals $N = 140 + 120 = 260$

So, $p = 140/260 = 0.54$

$q = 1-0.54 = 0.46$

Now we can easily find out M_p, M_q and σ_t as discussed in details in the previous sections.

Total scores on an opinion scale	Yes	No	Total	Higher group x'	f x'	Lower group y'	fy'	Entire group z'	fz'	fz'^{2}
190-199	10	0	10	4	40	4	0	4	40	160
180-189	20	0	20	3	60	3	0	3	60	180
170-179	12	7	19	2	24	2	14	2	38	76
160-169	40	17	57	1	40	1	17	1	57	57
150-159	25	42	67	0	0	0	0	0	0	0
140-149	16	28	44	-1	-16	-1	-28	-1	-44	44
130-139	12	14	26	-2	-24	-2	-28	-2	-52	104
120-129	5	6	11	-3	-15	-3	-18	-3	-33	99
110-119	0	6	6	-4	0	-4	-24	-4	-24	96
	N_1 =140	N_2 = 120	N= 260		∑f x'= 109		∑ fy'= -67		∑ fz' = 42	∑ fz'^{2}= 816

Here, Assumed mean (A) = (150+159)/2 = 154.5

So, $M_p = A + [\sum(fx')/N_1] \times i = 154.5 + (109/140) \times 10 = 154.5 + 7.78 = 162.28$

$M_q = A + [\sum(fy')/N_2] \times i = 154.5 + (-67/120) \times 10 = 154.5 - 5.58 = 148.92$

$= 10 \times 1.814 = 18.14$

Formula for computing coefficient of point biserial correlation is

$$r_{p,bis} = (M_p - M_q)/\sigma_t \times \sqrt{(pq)}$$

$$= (162.28 - 148.92)/18.14 \times \sqrt{(0.54 \times 0.46)}$$

$$= 13.36/18.14 \times 0.4984 = 0.37$$

Hence, the coefficient of point biserial correlation is 0.37

The Phi (φ) coefficient:

In education and psychology we sometimes come across two variables which are genuinely dichotomous, they cannot be thought of as representing underlying normal distribution. For example, test items are often scored True or False, Yes or No , with no intermediate answers being allowed. In this situation to find out correlation between two such genuinely dichotomous variables which can take only one of two values, we have to compute the phi (φ) coefficient.

The formula for computation of the phi (φ) coefficient is

$$\varphi = (AD - BC) / \sqrt{(A + B)(C + D)(B + D)(A + C)}$$

Where A, B, C, D represent the frequencies in the cells of the following 2 X 2 table:

X – Variable

		Yes	No	Total
Y-Variable	Yes	A	B	A + B
	No	C	D	C + D
	Total	A + C	B + D	A+B+C+D

The use of this formula will be understood clearly with the help of an example given below:

Example: 100 individuals in a survey sample responded to item nos. 12 and 19 of an interest inventory (in 'yes' or 'no') as given in the following table. Compute the phi (φ) coefficient with the help of cell frequencies.

Item No. 12

		Yes	No	Total
Item	Yes	28	23	51
No. 19	No	20	29	49
	Total	48	52	100

Solution: Here, A= 28, B = 23, C= 20, D = 29

Now, $\varphi = (AD - BC) / \sqrt{(A + B)(C + D)(B + D)(A + C)}$

$= (28 \times 29 - 23 \times 20) / \sqrt{(28+23) (20+29) (23+29) (28+20)}$

$= (812 - 460) / \sqrt{(51 \times 49 \times 52 \times 48)}$

$= 352 / \sqrt{6237504}$

$= 352 / 2497.5$

$= 0.14$

So, the φ coefficient = 0.14

Regression Analysis:

When two variables are correlated it will be possible to predict the measure of a variable for a given measure of another variable. If the correlation is perfect (i.e., the correlation coefficient is 1) , then the correlation will be correct. In most of the data related to education and psychology, the correlations are hardly found to be correct. Therefore, for reliable prediction, we generally use the concept of regression lines and regression equations. In a scatter diagram of the scores of two variables, if we try to compute the means for each of the columns, we may find that they all lie on a straight line. Similarly, the means for each of the rows may also be found to fall nearly in a straight line. Each of these straight lines is known

as the line of regression. One of these regression lines is linked with the regression of Y variable on X variable and is represented by the equation

$$Y - M_y = r\,(\sigma_y/\sigma_x)\,(X - M_x)$$

From the above equation we can predict the score of Y variable in correspondence with any value of the X variable.

The another regression line is linked with the regression of X variable on Y variable and is represented by the equation

$$X - M_x = r\,(\sigma_x/\sigma_y)\,(Y - M_y)$$

In the above two equations M_x and M_y represent means for the X and Y variable respectively, σ_x and σ_y represent the values of standard deviations for the distributions of and Y scores, and r represents Pearson's r for the variables X and Y.

Use of Regression lines:

Computation of regression equations when all the desired statistics are given.

From the following example we can understand the above use.

Example: Given the following data:

Marks in Mathematics (X)	Marks in Science (Y)
$M_x = 72$	$M_y = 80$
$\sigma_x = 5$	$\sigma_y = 6$

$r = 0.75$

Determine the regression equations and predict

i) The marks of science of a student whose marks in mathematics is 60 and
ii) The marks in mathematics of a student whose marks in science is 70.

Solution: The equation for prediction of Y is :

$$Y - M_y = r\,(\sigma_y/\sigma_x)\,(X - M_x)$$

Putting all the given values in the above equation we can have

$$Y - 80 = 0.75 \times (6/5) \times (60 - 72)$$

$$= -0.75 \times 14.4$$

$$= -10.8$$

So, $Y = 80 - 10.8 = 69.2$

The equation for prediction of X is

$$X - M_x = r\,(\sigma_x/\sigma_y)\,(Y - M_y)$$

Putting all the given values in the above equation we have

$$X - 72 = 0.75 \times (5/6)\,(70 - 80)$$

$$= -0.75 \times 8.33 = -6.3$$

So, $X = 72 - 6.3 = 65.7$

Other uses of Regression lines:

i) We can compute regression equations from the scatter diagram data and
ii) We can compute regression equations directly from raw data.

3.5 Inferential Statistics

3.5.1 Some basic concepts:

Sampling error :

We know that sample are selected from population by different ways. The measures estimated from population are called parameter and the measures estimated from the samples are called statistics . It is not possible to compute parameters, but there is a statistical procedure to predict parametrs from sample statistics. There is always some difference between sample estimate and the population value. This difference is called error. Saple studies are subject to sampling and non-sampling errors which are of a random and/or of a constant nature. The errorr which are due to sampling and of which the average magnitude can be determined are called sampling errors.

Standard error of means:

From the above discussion we get an idea that there is a difference between parameter and statistics. In an ideal case, a sample mean must represent the population mean, but on application , a sample mean is likely to differ from its parameter or true value. This difference is known as the possible error that may occur in estimating the true mean from a given sample. The curve representing the distribution of sample means possesing lesser or greater error of estimation for the population mean is called the curve of the error and the standard deviation of this distribution of sample means is known as the standard error of the mean.

In a large sample, the standard error of the mean may be computed with the help of the following formula:

$$\text{Standard Error of the Mean} = \sigma / \sqrt{N}$$

Where N is the total number of cases in the sample and σ is the standard deviation of the distribution of the sample means.

Confidence level

We know that a sample mean is employed to estimate the population mean. But in actual case, all the sample means drawn from the same population deviate in one way or the other form from the population mean . The standard error of the mean represents a measure by which the sample means deviate from the overall populaion mean. Now the question is by how much should a sample mean deviate from the population mean so that it may be taken as a trustworthy estimate of the population mean. The answer lies in the limits of confidence intervals fixed on the basis of degree of confidence required in a particular situation. Generally we make use of 0.95 (or 0.05) and 0.99 (or 0.010 percetage of probability as the

two known degrees of confidence for specifying the interval within which we may assert the existence of the poplation mean.

From the normal distribution we know that 95% cases lie within the limits $M \pm 1.96\ \sigma$ and 99% cases lie within the limits $M \pm 2.58\ \sigma$. The values in terms of scores of the limits $M \pm 1.96\ \sigma_M$ and $M \pm 2.58\ \sigma_M$ (σ_M is the sample mean) are called confidence limits and the interval they contain is called the confidence interval for a known and fixed degree or a level of confidence. Generally we say 5% level of confidence to represent that our population mean may lie within the range of $M \pm 1.96\ \sigma_M$ and 1% level of confidence to represent that our population mean may lie within the range of $M \pm 2.58\ \sigma_M$.

Degrees of Freedom

Degrees of freedom literally refer to the number of data values that are free to vary. For example, suppose the mean of a sample is 20, and there are a total of four values in the sample. It turns out that if any three of the values is given, then it is easy to find out the fourth value. If three of the values are 22, 18, 23, then the fourth value will be 17.

In other words, if the mean is known and all but one value is known , then one can figure out the missing value. All the values except one are free to vary. One value is set once the others are known. Thus, degree of freedom is equal to n-1.

One- tail test and two-tail test

One important concept in significance testing is whether to use a one-tailed or two-tailed test of significance. The answer is that it depends on your hypothesis. When your research hypothesis states (or implies) the direction of the difference or relationship, then you use a one-tailed probability. For example, a one-tailed test would be used to test these null hypotheses: Females will not score significantly higher than males on an IQ test. Blue collar workers will not have significantly lower education than white collar workers. Superman is not significantly stronger than the average person. In each case, the null hypothesis (indirectly) predicts the direction of the expected difference. A two-tailed test would be used to test these null hypotheses: There will be no significant difference in IQ scores between males and females. There will be no significant difference between blue collar and white

collar workers. There is no significant difference in strength between Superman and the average person. A one-tailed probability is exactly half the value of a two-tailed probability.

There is a raging controversy (for about the last hundred years) on whether or not it is ever appropriate to use a one-tailed test. The rationale is that if you already know the direction of the difference, why bother doing any statistical tests. The safest bet is to always state your hypotheses so that two-tailed tests are appropriate.

Type I error and Type II error

There are two types of hypothesis testing errors. The first one is called a Type I error. This is a very serious error where you wrongly reject the null hypothesis. Suppose that the null hypothesis is: Daily administrations of drug ABC will not help patients. Also suppose that drug ABC is really a very bad drug, and it causes permanent brain damage to people over 60. In your research, you ask for volunteers, and the entire sample is under 60 years of age. The sample seems to improve and you reject the null hypothesis. There could be very serious consequences if you were to market this drug (based on your sample). Type I errors are often caused by sampling problems.

A Type II error is less serious, where you wrongly fail to reject the null hypothesis. Suppose that drug ABC really isn't harmful and does actually help many patients, but several of your volunteers develop severe and persistent psychosomatic symptoms. You would probably not market the drug because of the potential for long-lasting side effects. Usually, the consequences of a Type II error will be less serious than a Type I error.

3.5..2 Student t-test:

t-test is used to find out the significant difference between two means. It is a parametric test.When we carry out various studies in the fields of Education and Psychology, we often need to test the significance of the difference between two sample means drawn from same or different populations.

Let us take two examples:

i) A teacher of mathematics develops a new teaching method and he wants to know whether the new method or the traditional is better. For this purpose he divides the

students of class VIII into two equivalent groups. He teaches one group by his new method and other group by traditional method. After some days he takes an achievement test to both groups and computes the means of the respective achievement scores of the two groups. The difference between the two means is determined. Now the question arises as to how significant this difference should be to help decide whether new teaching method or traditional method is better. [UN CORRELATED DATA]

ii) A teacher of mathematics wants to know the effect of anxiety on the computational ability in mathematics. For this purpose, he takes an achievement test in mathematics to a group of students and then calculates the mean score of the achievement test. Then he induces a state of anxiety among the students. Then he re-administers the achievement test to the same group of students and calculates the mean score of the achievement test. The difference between two means is computed. Now to know the effect of anxiety on the achievement of the group, the teacher has to take a decision about the significance of the difference between two means. [CORRELATED DATA]

Note: A difference is called *significant* when the probability is high that it cannot be attributed to chance (i.e., temporary and accidental factors) and hence represents a true difference between population means.

A difference is called *nonsignificant* when it appears reasonably certain that it could easily have arisen from sampling fluctuations, and hence implies no real or true difference between the population means.

How to determine the significance of difference between two means:

The process of determining the significance of difference between two sample means varies with respect to the largeness or smallness of the samples as well as the relatedness or un relatedness of the samples.

Here, by a large sample we mean the samples having 30 or more cases and by a small sample, the sample consisting less than 30 cases.

We call the samples independent when they are drawn at random from the totally different and unrelated groups . The samples are dependent when they are from same or correlated groups.

The steps of this process are as follows:

i) Set up a null hypothesis

ii) Decide about level of significance

iii) Determine the Standard Error (SE) of the difference between two means

iv) Compute z score (for large samples) or t-ratio (for small samples)

v) Testing the null hypothesis

Case I: Significance of difference between two means for large but uncorrelated samples

Let us try to understand the steps with a suitable example:

A science teacher wanted to know the relative effectiveness of Laboratory method over the traditional Lecture method. He divided his class into two equal random groups A and B and taught group A by Laboratory method and group B by the Lecture method. After teaching two months, he administered an achievement test to both groups. The data collected are as under

	Group A	*Group B*
Mean	*43*	*30*
SD	*8*	*7*
No of students	*65*	*65*

From this data, what do you conclude about the effectiveness of one method of teaching over the other?

Step 1: The Null hypothesis may be stated as : There exists no real difference between the means of two samples.

Step 2: Level of significance .01 or .05

Step 3: In this case, Standard Error (SE) of the difference between the means of two samples will be

$$\sigma_D = \sqrt{(\sigma_1^2/N_1 + \sigma_2^2/N_2)}$$

Now $\sigma_1 = 8$, $N_1 = 65$ $\sigma_2 = 7$, $N_2 = 65$

So, $\sigma_D = \sqrt{(8x8/65 + 7x7/65)} = 1.32$

Step 4 ; Calculation of z value

$$z = (M_1 \sim M_2) / \sigma_D$$

Here, $M_1 = 43$ and $M_2 = 30$

So, $z = (43-30)/ 1.32 = 9.85$

Step 5: Testing the Null hypothesis

It is a two tailed test.

Computed z value is much higher than 1.96 as well as 2.58, the critical values required to reach .05 and .01 levels of significance respectively. Thus we may safely conclude that the difference between means is quite significant at .01 level (and obviously at .05 level) . So, the null hypothesis is rejected that means Laboratory method is more effective method of teaching than lecture method.

Case II: Significance of difference between two means for small but uncorrelated samples

Let us try to understand the steps with a suitable example:

A language teacher assumes that news paper reading will increase vocabulary. For this purpose he divides his class into two groups – experimental and control. The experimental group was given two hours daily to read English news papers and magazines, while no such facility is provided to control group. After six months, both the groups were given a vocabulary test. The scores obtained are detailed below:

Experimental group: 115, 112, 109, 112, 117

Control group: 110, 112, 95, 105, 111, 97, 112, 102

Interpret the data and say whether the gain vocabulary is significant.

In this case, Standard Error (SE) of the difference between the means of two samples will be

$$\sigma_D = \sigma\sqrt{(1/N_1 + 1/N_2)}$$

Where σ is called pooled SD and is given by

$$\sigma = \sqrt{(\sum x_1^2 + \sum x_2^2) / (N_1 - 1 + N_2 - 1)}$$

Where

$x_1 = X_1 - M_1$ (deviation of scores of first samples from its mean)

$x_2 = X_2 - M_2$ (deviation of scores of 2nd samples from its mean)

From the above data,

$M_1 = 113$ and $N_1 = 5$

$\sum x_1^2 = (115-113)^2 + (112-113)^2 + (109- 113)^2 + (112-113)^2 + (117-113)^2 = 38$

$M_2 = 105.5$ and $N_2 = 8$

$\sum x_2^2 = (110-105.5)^2 + (112-105.5)^2 + (95- 105.5)^2 + (105-105.5)^2 + (111-105.5)^2 + (97-105.5)^2 + (112-105.5)^2 + (102-105.5)^2 = 330$

Pooled SD, $\sigma = \sqrt{(38 + 330) / (5-1 + 8-1)} = 5.79$

So, $\sigma_D = \sigma\sqrt{(1/N_1 + 1/N_2)} = 5.79\sqrt{(1/5 + 1/8)} = 3.30$

Calculation of t value

$$t = (M_1 \sim M_2) / \sigma_D$$

Here, $M_1 = 113$ and $M_2 = 105.5$

So, $z = (113 - 105.5) / 3.30 = 2.27$

It is a one-tailed test.

We will refer to the t table with 5+8-2 = 11 degrees of freedom and locate the t value under the column 0.10 for determining the critical value of t at the 0.05 level. Consequently at 5% level of significance the critical value of t = 1.80. But our computed value of t is 2.27 which is greater than the critical value. So we can reject the null hypothesis at .05 level of confidence and say that the reading drill through news papers and magazines increases the vocabulary.

How to determine the significance of difference between two means for correlated samples- large and small

The procedure followed for testing the significance of difference between two means for correlated samples is almost same *except for the difference in the process of computation of the standard error.*

Here, by a large sample we mean the samples having 30 or more cases and by a small sample, the sample consisting less than 30 cases.

The samples are correlated when the data in one sample correlated with the data in the other.

The steps of this process are as follows:

i) Set up a null hypothesis

ii) Decide about level of significance

iii) Determine the Standard Error (SE) of the difference between two means

iv) Compute z score or t-ratio

v) Testing the null hypothesis

Different methods for making correlated samples

The Single group method: It consists of repetition of a test to a group. In actual process, a test of any type is administered to a group of subjects . It is called the initial test. Then the desired experimental treatment is given, followed by re-administration of the same test to the same individuals of the group. The initial and final tests data thus constitute a correlated data because the same individuals are responding to the items both times, i.e. before and after the treatment

Equivalent groups method: In experiments , when we have to compare the relative effect of the method or treatment over the other, we often make use of two groups (experimental and control). Then we give the desired treatment separately to the individuals of these groups and compute the pre-treatment and post-treatment scores by administering a test or a measure. Hence in such experimental design, instead of a single group, two separate groups are taken for the experimental study. But these two groups must be Equivalent. The two groups are made equivalent in the following ways:

Matching pair technique: In this technique, matching is done initially by pairs so that each individual in the first group has his equivalent or match in the second group in terms of some variables who are going to affect the results of the study like age, socio-economic status, intelligence, interest, aptitude etc.

Matching group technique: Here, instead of one to one correspondence or matching carried out in pairs on an individuals level, the group as awhole is matched with the other group in terms of mean and standard deviation of some other variable/variables than the one under study.

Formula for computation of the standard error:

i) For the two groups matched in pairs as well as in case if a single group is tested twice (before starting the experiment and later) , we use the formula

$$\sigma_D = \sqrt{(\sigma_{m1}^2 + \sigma_{m2}^2 - 2r \sigma_{m1} \sigma_{m2})}$$

where σ_{m1} = standard error of the mean of the initial test

σ_{m2} = standard error of the mean of the final test

r = coefficient of correlation between scores on initial and final testing

ii) For the two groups matched in terms of the group as a whole (i.e. mean and standard deviation), the formula is

$$\sigma_D = \sqrt{(\sigma_{m1}^2 + \sigma_{m2}^2) (1 - r^2)}$$

where σ_{m1} and σ_{m2} are the standard errors of the means of the scores of X variable under study for the two groups which are matched or equated to mean and SD in terms of other variable, Y .

r is the measure of coefficient of correlation between X and Y.

Let us try to understand the steps with a suitable examples:

A teacher of mathematics gave a test in multiplication to the 30 students of his class. Then he induced a state of anxiety among them and the achievement test was re-administered. The data obtained are as follows

	Initial test data	*Final test data*
Mean	*70*	*67*
SD	*6*	*5.8*

r between the initial and final test scores = 0.82

From this data, test the hypothesis that the introduction of the state of anxiety affect the multiplication ability of the students adversely.

The Null hypothesis may be stated as : There exists no real difference between the means of two samples.

Here, $\sigma_D = \sqrt{(\sigma_{m1}^2 + \sigma_{m2}^2 - 2r\, \sigma_{m1}\, \sigma_{m2})}$

Now, σ_{m1} = standard error of the mean of the initial test = $\sigma_1/\sqrt{N_1} = 6/\sqrt{(30)}$

$= 1.09$

σ_{m2} = standard error of the mean of the final test $= \sigma_2/\sqrt{N_2}$

$= 5.8/\sqrt{(30)} = 1.06$

$\sigma_D = \sqrt{(\sigma_{m1}^2 + \sigma_{m2}^2 - 2r\, \sigma_{m1}\, \sigma_{m2})} = \sqrt{((1.09)^2 + (1.06)^2 - 2x\ 0.82x1.09x1.06)}$

$= 0.648$

Calculation of z value

$$z = (M_1 \sim M_2) / \sigma_D$$

Here, $M_1 = 70$ and $M_2 = 67$

So, $z = (70-67)/ 0.648 = 4.629$

It is a one-tailed test

Computed z value is much higher than 1.96 as well as 2.58, the critical values required to reach .05 and .01 levels of significance respectively. Thus we may safely conclude that the difference between means is quite significant at .01 level (and obviously at .05 level) . So, the null hypothesis is rejected that means introduction of the state of anxiety has affected adversely the multiplication ability of the students.

Another example:

Two groups of tenth grade students are matched for mean and SD on a group intelligence test. There are 58 subjects in group A and 72 in group B. The records of these two groups upon a battery of learning tests are as follows:

	Group A	*Group B*
Mean	*48.52*	*53.35*
SD	*10.61*	*15.35*
N	*58*	*72*

The correlation of the group intelligence test and the learning battery in the entire group from which A and B were drawn is 0.50

From this data, test the significance of the difference between groups A and B at .05 and .01 levels.

The groups are matched in terms of mean and standard deviation.

So, to determine the Standard Error of the difference between two means, the formula to be used is

$$\sigma_D = \sqrt{(\sigma_{m1}^2 + \sigma_{m2}^2) (1 - r^2)}$$

Now, $\sigma_{m1} = \sigma_1/\sqrt{N_1} = 10.60/\sqrt{(58)}$

$$\sigma_{m2} = \sigma_2/\sqrt{N_2}$$

$$= 15.35/\sqrt{(72)}$$

So, $\sigma_D = \sqrt{(10.60^2 / 58 + 15.35^2/72) (1 - 0.5^2)} = 1.97$

Calculation of z value

$$z = (M_1 \sim M_2) / \sigma_D$$

Here, $M_1 = 53.61$ and $M_2 = 48.52$

So, $z = (53.61 - 48.52)/ 1.97 = 2.58$

For the significance at .05 and .01 levels, the critical z values are 1.96 and 2.58 respectively. Our computed value of z is 2.58; hence it may be taken to be quite significant at the .05 level and almost significant at the .01 level.

3.5.3 ANALYSIS OF VARIANCE (ANOVA)

z and t tests are used for testing the significance of the difference between the means of two samples or groups.

Let us suppose we have five random samples and we want to determine whether there are any significant differences among their means. For this purpose we have to use ten (10) t tests to determine the significance of the difference between the five means by taking two means at a time. The procedure is cumbersome and time taking.

Analysis of variance is the composite procedure for testing simultaneously the difference between several sample means by a single test, called F test. The F test enables us to determine whether sample means differ from one another (*between group variance*) to a greater extent than the test scores differ from their own sample means (*within group variance*) using the ratio:

F = (Variance between groups) / (Variance within groups)

F ratio helps us to know whether any of the differences between means of the given samples are significant. If the answer is 'yes', we examine pairs (with the help of t test) to see just where the significant differences lie. If the answer is 'No', we do not proceed further.

Basic Assumptions of Analysis of Variance:

i) The population distribution should be normal.

ii) All the groups of a certain criterion should be randomly chosen from sub-population having the same criterion.

iii) The sub-groups under investigation should have the same variability.

Procedure for the Analysis of Variance

The procedure for the analysis of variance involves many tasks and all these tasks may be carried out in a series of systematic steps.

Let us illustrate all steps of analysis of variance technique with the help of an example:

A researcher wants to determine the effect of three different techniques of training on the learning of a particular skill. For this purpose, three groups of ten students, each randomly selected from class VIII of a school were taken and given training through these different techniques. The scores obtained on a performance test were recorded as follows:

Group I: 13, 8, 16, 15, 12, 11, 12, 14, 9, 10

Group II: 10, 11, 13, 9, 7, 5, 6, 8, 7, 6

Group III : 9, 10,11, 10, 8, 10, 7, 11, 10, 9

Significance of the difference between group means can be tested applying the analysis of variance technique as follows:

Step 1: Arrangement of data into a proper table and initial computation

Gr I (X_1)	Gr II (X_2)	Gr III (X_3)	Total (X)
13	10	9	32
8	11	10	29
16	13	11	40
15	9	10	34
12	7	8	27
11	5	10	26
12	6	7	25
14	8	11	33
9	7	10	26
10	6	9	25
$\sum X_1 = 120$	$\sum X_2 = 82$	$\sum X_3 = 95$	$\sum X = 297$

Mean of GrI = 120/10 =12

Mean of GrII = 82/10 = 8.2

Mean of Gr III = 95/10=9.5

Correction term $C = (\sum X)^2 / N = (297 \times 297) / 30 = 2940.3$

Step 2: Squared table computation

X_1^2	X_2^2	X_3^2	Total
169	100	81	350
64	121	100	285
256	169	121	546

225	81	100	406
144	49	64	257
121	25	100	246
144	36	49	229
196	64	121	381
81	49	100	230
100	36	81	217
---	---	---	---
$\sum X_1^2 = 1500$	$\sum X_2^2 = 730$	$\sum X_3^2 = 917$	$\sum X^2 = 3147$

Step 3: Total sum of squares (S_t^2):

This is given by :

$$S_t^2 = \sum X^2 - (\sum X)^2 / N = \sum X^2 - C$$

$$= 3147 - 2940.3 = 206.7$$

Step 4: Between group sum of squares (S_b^2):

This is given by :

$$S_b^2 = (\sum X_1)^2 / N_1 + (\sum X_2)^2 / N_2 + (\sum X_3)^2 / N_3 - C$$

$$= 120X120 / 10 + 82X82/10 + 95X95/10 - 2940.3$$

$$= 1440 + 672.4 + 902.5 - 2940.3$$

$$= 74.6$$

Step 5: Within- groups sum of squares (S_w^2):

This is given by:

$$S_w^2 = S_t^2 - S_b^2$$

$$= 206.7 - 74.6 = 132.1$$

Step 6: No. of degrees of freedom :

df for $S_t^2 = N - 1 = 30 - 1 = 29$

df for $S_b^2 = K - 1 = 3 - 1 = 2$

df for $S_w^2 = N - K = 30 - 3 = 27$

Step 7: Calculation of F -ratio:

Source of Variance	Sum of squares	df	Mean Squa
Between groups	74.6	2	74.6/2 = 37.3
Within groups	*132.1*	*27*	*132.1/ 27 = 4.89*

F = (Mean square variance between groups) / (Mean square variance within groups)

= *37.3 / 4.89 = 7.63*

Step 8 : Interpretation of F- ratio:

The F-ratio table is now referred for 2 degrees of freedom for greater mean square variance and 27 for degrees of freedom for smaller mean square variance.

From the F ratio table we see critical value of F = 5.49 at .01 level of significance. Our computed value of F is 7.63 which is much higher than the critical value at .01 level. Hence it should be taken as quite significant. So, we have to reject null hypothesis. Thus, a significant difference definitely exists between the group means. Let us further test to find out where these difference exist.

Step 9: Application of t test:

Let us first test the difference between Group I and Group II:

Mean of GrI = 12, Mean of Gr II = 8.2

Now $t = (12 - 8.2) / \sigma_D = 3.8 / \sigma_D$

Where $\sigma_D = \sigma (1/N_1 + 1/N_2)$

σ is the square root of the value of within-groups mean square variance = $\sqrt{4.89}$

= 2.21

And $N_1 = N_2 = 10$

Hence $\sigma_D = 2.21 \text{ X } (1/10 + 1/10) = 2.21 \text{ X } 0.2 = 0.442$

Therefore, t = 3.82 / 0.442 = 8.64

Now df for within groups sum of squares is N-K =27

From the t- distribution table critical values of t = 2.77 at .01 level of significance.

The computed value of t is much than the above value. Hence it is to be regarded as quite significant. So, null hypothesis is rejected.

So we can conclude that the difference between the means of Gr I and Gr II is quite significant and real.

Similarly, the significance of difference between the means of Gr II and Gr III; and Gr I and Gr III can be tested applying t test as discussed above.

3.5.4 ANALYSIS OF COVARIANCE (ANCOVA)

Analysis of covariance is an extension of analysis of variance where a correlation between the initial and final scores is established. ANCOVA helps a researcher in exercising proper statistical control over the uncontrolled covariates that have been left uncontrolled at the start of the study. When a researcher faces problems fo form equivalent groups for studying the relative effectiveness of one or other treatments, then he can use ANCOVA to get rid of such difficulties because this technique root out the effect of initial differences that exist in the behaviour of the groups.

Procedure for the Analysis of Covariance

The procedure for the analysis of covariance involves many tasks and initially these tasks have much similarity with the procedure for the analysis of variance.

Let us illustrate all steps of analysis of covariance technique with the help of an example:

Example: A researcher wanted to the relative effectiveness of grammar, translation and structural methods of teaching English. He performed the experiment with the help of 12 students by dividing them at random into three groups. The initial scores (before starting the experiment) and final scores (after teaching each group by different methods) were recorded as follows. Find the relative effectiveness of these three methods.

Gr I		Gr II		Gr III	
Initial (X_1)	Final (Y_1)	Initial (X_2)	Final (Y_2)	Initial (X_3)	Final (Y_3)
33	18	34	31	34	15
42	34	55	45	4	8
40	22	9	1	12	18
31	24	50	33	16	15

Here no attempt was made to make the three groups as equivalent groups. So, in this case technique of analysis of covariance must be applied for statistical control. Let us start with arranging the given data as in the following table.

	Gr I					Gr II					Gr III				
	X_1	Y_1	X_1Y_1	X_1^2	Y_1^2	X_2	Y_2	X_2Y_2	X_2^2	Y_2^2	X_3	Y_3	X_3Y_3	X_3^2	Y_3^2
	33	18	594	1089	324	34	31	1054	1156	961	34	15	510	1156	225
	42	34	1428	1764	1156	55	45	2475	3025	2025	4	8	32	16	64
	40	22	880	1600	484	9	1	9	81	1	12	18	216	144	324
	31	24	744	961	576	50	33	1650	2500	1089	16	15	240	256	225
Sum	146	98	3646	5414	2540	148	110	5188	6762	4076	66	56	998	1572	838
Mean	36.5	24.5				37	27.5				16.5	14			

For all the three groups,

$\sum X = 146 + 148 + 66 = 360$, $\sum Y = 98 + 110 + 56 = 264$

$\sum X^2 = 5414 + 6762 + 1572 = 13748$, $\sum Y^2 = 2540 + 4076 + 838 = 7454$

$\sum XY = 3646 + 5188 + 998 = 9832$

Step 1: Computation of correction terms:

$C_X = (\sum X)^2 / N = (360)^2 / 12 = 10800$

$C_Y = (\sum Y)^2 / N = (264)^2 / 12 = 5808$

$C_{XY} = (\sum X \times \sum Y) / N = (360 \times 264) / 12 = 7920$

Step 2: Computation of total sum of squares:

$SS_X = \sum X^2 - C_X = 13748 - 10800 = 2948$

$SS_Y = \sum Y^2 - C_Y = 7454 - 5808 = 1646$

$SS_{XY} = \sum XY - C_{XY} = 9832 - 7920 = 1912$

Step 3: Computation of sum of squares (SS) among the means of the groups:

SS among-means for $X = (\sum X_1)^2 / N_1 + (\sum X_2)^2 / N_2 + (\sum X_3)^2 / N_3 - C_X$

$= 146^2 / 4 + 148^2 / 4 + 66^2 / 4 - 10800$

$= 5329 + 5476 + 1089 - 10800 = 1094$

SS among-means for $Y = (\sum Y_1)^2 / N_1 + (\sum Y_2)^2 / N_2 + (\sum Y_3)^2 / N_3 - C_Y$

$= 98^2 / 4 + 110^2 / 4 + 56^2 / 4 - 5808$

$= 2401 + 3025 + 784 - 5808$

$= 402$

SS among-means for XY $= \sum X_1 \sum Y_1 / N_1 + \sum X_2 \sum Y_2 / N_2 + \sum X_3 \sum Y_3 / N_3 - C_{XY}$

$= 146 \times 98 / 4 + 148 \times 110 / 4 + 66 \times 56 / 4 - 7920$

$= 3577 + 4070 + 924 - 7920$

$= 651$

Step 4: Computation of sum of squares (SS) within-groups:

Within-groups SS for X $= SS_X -$ SS among-means for X

$= 2948 - 1094 = 1854$

Within-groups SS for Y $= SS_Y -$ SS among-means for Y

$= 1646 - 402 = 1244$

Within-groups SS for XY $= SS_{XY} -$ SS among-means for XY

$= 1912 - 651 = 1261$

Step 5: Calculation of the number of degrees of freedom:

Among- means df = K – 1 = No. of groups – 1 = 3 – 1 = 2

Within-groups df = N – K = 12 – 3 = 9

Step 6: Analysis of variance of X and Y scores taken seperately:

Source of Variation	df	SS_X	SS_Y	MS_X (Mean square variance for X)	MS_Y (Mean square variance for Y)
Among-means	2	1094	402	1094 / 2 = 547	402 / 2 = 201
Within-groups	9	1854	1244	1854 / 9 = 206	1244 / 9 = 138.2
Total	11	2948	1646		

F_X = (Mean square variance of among-groups for X) / (Mean square variance of within-groups)

= 547 / 206 = 2.65

F_Y = (Mean square variance of among-groups for Y) / (Mean square variance of within-groups)

= 201 / 138.2 = 1.45

Where F_X = F ratio for X and F_Y = F ratio for Y

From the Table of critical value of F for df (2,9) we can have the corresponding values of F at 0.05 level is 4.26 and at 0.01 level is 8.02.

Here the computed value of F for X scores and that for Y scores are less than the critical values of F at both levels. That means F_X and F_Y are not significant. So H_o is to be accepted and we can conclude that the groups do not differ significantly initially and also finally. As far as this example is concerned, the matter ends with drawing the inference that the three methods do not differ significantly. But if F_X and F_Y are both significant, the H_0 is to be rejected and we have proceed further for ANCOVA as follows.

Step 7: Computation of adjusted sum of squares (SS for Y i.e. SS_{YX}):

If F_X is sigificant then it is said that there is a significant difference in X scores of the groups. This initial difference may cause variability in their final scores measured after giving treatment. For this purpose, necessary adjustments are made in various sum of squares for Y using the following general formula:

$$SS_{YX} = SS_Y - (SS_{XY})^2/SS_X$$

Here SS_{YX} is the sum of squares of Y adjusted for X differences and the values of SS_{YX} are measured for within-groups means and among-groups means.

Step 8: Computation of Analysis of *Covariance:*

After finding out SS_{YX} for among-groups means and within-groups means, the next step is to find out the variance of SS_{YX} in both cases i.e. V_{YX} among- groups and V_{YX} within-groups; and then to find out F_{YX} where F_{YX} is given by the formula

$$F_{YX} = (V_{YX} \text{ among- groups}) / (V_{YX} \text{ within- groups})$$

If the value of F_{YX} is not significant at 0.05 or 0.01 levels then H_0 is to be accepted and we can conclude that groups do not differ significantly after giving treatments. But if H_0 is rejected, then we have to analyse further and to find out which treatment is better. And for this we have to find out the *regression coefficient for within the groups* and then *adjusted Y means* and finally *significance of differences among adjusted Y means* using t-test.

3.5.5 χ^2 TEST

1. χ^2 (Chi square) distribution was first discovered by Helmert in 1875 and then rediscovered independently by Karl Pearson in 1900, who applied it as a test of 'goodness of fit'.

2. As a test of 'goodness of fit', Karl Pearson tried to use of the χ^2 distribution for devising a test for determining how well the experimentally obtained results fit in the results expected theoretically on some hypotheses (Viz. Hypothesis of equal probability or chance factor / Hypothesis of normal distribution)

3. χ^2 (Chi square) test is used for two broad purposes. As already stated, it is used as a test of 'goodness of fit' and secondly, as a test of independence.

Procedure of χ^2 Testing

The procedure of utilizing χ^2 as a test of goodness of fit or significance may be summarized as follows :

Setting the null hypothesis: In the beginning a null hypothesis is set up. The null hypothesis may be stated that there exists no actual difference between the observed frequencies (derived from experimental results) and expected frequencies (derived on the basis of some hypothesis of equal probability or chance factor or hypothesis of normal distribution).

Computation of the value of χ^2

In the next step the value of χ^2 is calculated. The usual formula for the calculation of χ^2 is as follows:

$$\chi^2 = \sum [(f_o - f_e)^2 / f_e]$$

Where

f_o = Observed frequency on some experiment

f_e = Expected frequency on some hypothesis

Determining the number of degrees of freedom

The formula for the computation of number of degrees of freedom in a chi square problem usually is as follows:

$$df = (r - 1) (c - 1)$$

where r = No. of rows in the contingency table

c = No. of columns in the contingency table

Determining the critical value of χ^2 and Interpretation of χ^2 with reference to the set hypothesis

The computed value of χ^2 is compared with the critical value of it read from the table and interpreted properly .

Let us illustrate all steps of the χ^2 Test with the help of examples:

Case I: Testing the divergence of observed results from those expected on the hypothesis of equal probability

Example: A one rupee coin is tossed in the air 200 times and the recorded results of these 200 throws indicate 80 heads and 120 tails. Using the χ^2 test, find out whether this result is better than mere "chance".

Here the Null hypothesis may be stated as:

There exists no real difference between observed and expected frequencies.

	f_o	f_e	f_o-f_e	$(f_o-f_e)^2$	$(f_o-f_e)^2/f_e$
Heads	80	100	-20	400	4
Tails	120	100	20	400	4

Now $\chi^2 = \sum [(f_o - f_e)^2 / f_e] = 4+4 = 8$

Degrees of freedom = (r-1) (c-1) = (2-1) (2-1) = 1

Let us refer to the Table of the chi square distribution with df = 1. We find that at .01 level of significance, the critical value of chi square is 6.635, Our computed value of chi square is 8 which is greater than 6.635. Hence, this value of chi square is significant at .01 level. So, we may safely reject the null hypothesis at .01 level of significance and be fairly confident that our experimental results are different from those produced merel by chance alone.

Case II: Testing the divergence of observed results from those expected on the hypothesis of normal distribution

Example: 42 salesman have been classified into 3 groups- very good, satisfactory, and poor- by a sales manager. Does this distribution of ratings differ significantly from that to be expected if selling ability is normally distributed in our population of salesman?

Here the Null hypothesis may be stated as:

There exists no real difference between observed and expected frequencies.

	f_o	f_e	f_o-f_e	$(f_o-f_e)^2$	$(f_o-f_e)^2/f_e$
Very good	16	6.7	9.3	86.49	12.90
Satisfactory	20	28.6	-8.6	73.96	2.59
Poor	6	6.7	-0.7	0.49	0.07

Now $\chi^2 = \sum [(f_o - f_e)^2 / f_e] = 12.90 + 2.59 + 0.07 = 15.56$

Degrees of freedom=(r-l) c-l)=(3-l) (2-l)=2

Here, the expected frequencies showing the number of salesman falling into the given three categories are to be determined on the basis of the normal distribution hypothesis. For this purpose, let us represent the position of the three categories diagrammatically on a normal curve by dividing the base line of the curve (taken to be 6σ) in to three equal segments of 2σ each. The proportion of the normal distribution to be found in each of these segments is as follows:

	proportion
Between +3 σ and +1 σ	16%
Between +1σ and -1 σ	68%
Between -1 σ and -3 σ	16%

Hence the corresponding expected frequencies are 6.7, 28.6 and 6.7

Let us refer to the Table of the chi square distribution with df = 2. We find that at .01 level of significance, the critical value of chi square is 9.210, Our computed value of chi square is 15.56 which is greater than 2.210. Hence, this value of chi square is significant at .01 level. So, we may safely reject the null hypothesis at .01 level of significance and be fairly confident that our experimental results are different those expected if the ability of the salesman is supposed to be distributed normally in our population.

Case III: Testing null hypothesis of independence in 2X2 contingency table

Example: *The mothers of two hundred adolescents were asked whether they agreed or disagreed on a certain aspect of adolescent behaviour. The data collected are as follows*

	Agree	Disagree	Total
Graduate mothers	38 (A)	12 (B)	50
Non graduate mothers	84 (C)	66 (D)	150
Total	122	78	200

Null hypothesis: Attitude of mothers is independent of the fact that they are graduates or non graduates.

Computing χ^2

From the contingency table we can compute the value of χ^2, by using the formula (with Yates' correction)

$$\chi^2 = [N(AD - BC)^2] / [(A+B)(C+D)(A+C)(B+D)]$$

$$= [200(38x66 - 84x12)^2] / [50X\ 150\ X\ 122\ X\ 78]$$

$$= 6.305$$

Here df =1. From the Table we have the critical value of χ^2 at .05 level of significance is 3.841 and at .01 level of significance is 6.635. But our computed value is 6.305 which is lower than the critical value at .01 level but higher than that at .05 level. So it is not significant at .01 level but significant at .05 level of significance. So, we can conclude that 95 times out of 100, the attitude of the mothers is quite independent of the fact that they are graduates or non graduates.

Yates' Correction for small frequencies

When we have a small sample of cases such that the least expected frequency in any cell of the 2x2 contingency table (with df=1) is less than 5 we need a correction called Yates' correction as follows:

Usual formula	*Corrected formula*
$\chi^2 = \sum [(f_o - f_e)^2 / f_e]$	$\chi^2 = \sum [(\| f_o - f_e \| -0.5)^2 / f_e]$
$\chi^2 = [N(AD - BC)^2] / [(A+B)(C+D)(A+C)(B+D)]$	$\chi^2 = [N(\|AD - BC\| - N/2)^2] / [(A+B)(C+D)(A+C)(B+D)]$

3.5.6 SIGN TEST

Sign test is a very simple non parametric test. The word 'sign' is used in this test because it uses plus (+) and minus (-) sign instead of quantitative measures of the data. This test is used for comparing two correlated parallel sets of measurement which are paired off in some way and the main aim of this test is to test the null hypothesis which states that the median difference between the pairs is zero. In applying the sign test we need not consider any assumption regarding the normality, homosedasticity of the distribution, and that all subjects are drawn from the same population. In this test the measurements in two parallel sets need not to be in interval or ratio scales, but is available in the form of ranking or showing the direction of differences.

Illustration of the use of Sign test for small samples (N< 25):

From the following example the use of sign test will be understable by the students.

Example: 12 students were rated by two different panels of judges for being selected as captain for a football team. Their pooled rating score on the two occassions are given in the

following table. Can you conclude from the data by using the Sign test that the opinion of panel 1 is better than panel 2 ?

Student	Rating scores of panel 1	Rating scores of panel 2	Sign of difference
1	14	13	+
2	10	12	-
3	9	8	+
4	11	13	-
5	8	6	+
6	12	14	-
7	13	13	0
8	6	5	+
9	14	11	+
10	18	16	+
11	16	14	+
12	15	11	+

Here, our first task is to determine the signs of difference (+ or -) . For zero difference we have to write 0. In the above example we see from the table that there are 8 plus (+) sign, 3 minus (-) sign and 1 zero (0) sign. As zero difference is neither plus nor minus signs, it can be eliminated from N (total no of students). So, in the present case N = 12-1 = 11.

In this case, we must know which opinion is better since there are more positve signs. Thus we can establish a one tailed hypothesis (H_1) that opinion of panel 1 is better than opinion of panel 2.

Here, the size of sample is small (< 25). The sign test is based on the idea that under the null hypothesis, we expect that difference between two rating scores will be half positive and half negative. Hence the probability associated with the occurence of a particular number + (p) and – (q) signs can be determined with reference to binomial distribution where p = q = ½. For this purpose we can use a Table of probabilities associated with values as small as observed values of x under H_0 in the binomial test where, x= no. of fewer signs (whether + or -).

Here, x = 3 (because in this case negative sign is fewer) and N = 11

From the above said Table , for N =11 and x=3, the one tailed probabilities of occurence under H_0 are $p = 0.113$

This value of p is higher than 0.05 (at 5% level of significance) and 0.01 (at 1% level of significance). Hence we accept H_0 in favour of H_1, we can safely conclude that opinion of panel 1 is not better than the panel 2. Note that, if p is lesser or equal to .05 or .01, the we reject H_0.

If N is larger than 25, then chi-square test may be used.

3.5.7 THE MANN-WHITNEY U TEST

1.The Mann-Whitney U test is a very useful non-parametric alternative to the t test for assessing the difference between two independent samples having uncorrelated data, especially in the circumstances when the assumptions and conditions for applying the t test are not met.

2. Like Median test, this test too is used to find out whether or not the two independent samples have been drawn from the same population. In this way, it is employed for comparing the population distributions from which samples under study have been drawn.

3. Using this test we try to find out the difference between population distributions, and not the difference between population means.

4. For this test, the data or scores for the two samples be at least in an ordinal scale.

Procedure for the U Test (for moderately large samples where any one of the two samples have freq between 9 and 20)

The procedure for the U Test involves many tasks and all these tasks may be carried out in a series of systematic steps. The steps are discussed by taking an example.

To know the effect of environmental conditions on the growth of intelligence of children, a researcher selects two groups- one from a Govt school (Gr A) and the other from a Private school (Gr B). The IQ scores of these two groups are given as follows:

Group A: 100, 112, 116, 108, 104, 105,98, 108, 121,125, 110, 117, 106, 116,118, 120 (N = 16)

Group B: 116, 110,99,112,118,97,110,90,94,115 (N = 10)

The steps are as follows:

Step 1: *Setting the hypothesis and level of significance:*

Null hypothesis : There is no significant difference between the distribution of intelligence in both the groups.

Level of significance: 0.05

Step 2: Combine the scores belonging to both the groups and rank them into a single group, giving rank 1 to the lowest. For the tied score, give the average of the tied ranks.

In the present example, the combined IQ scores are arranged in ascending order as follows:

90,94,97,98,99,100,104,105,106,108,108,109,110,110,112,112, 116,116,117, 117,118,118,119,120,121,125

The corresponding ranks are: 1,2,3,4,5,6,7,8,9, 10.5, 10.5, 12, 13.5, 13.5, 15.5, 15.5, 17.5, 17.5, 19.5,19.5,21.5,21.5, 23, 24,25, 26

Step 3: The ranks for each group are then summed up.

In the present example, the ranks are summed up as in the next Table

Group A	Rank	Group B	Rank
100	6	116	17.5
112	15.5	110	13.5
116	17.5	99	5
108	10.5	112	15.5
104	7	118	21.5
105	8	97	3
98	4	110	13.5
108	10.5	90	1
121	25	94	2
125	26	119	23
109	12		
117	19.5		
106	9		
117	19.5		
118	21.5		
120	24		
	R1=235.5		R2=115.5

Step 4: Computation of values of U

The values of U are computed from formula I and formula II as follows:

$U = N_1N_2 + N_1(N_1 +1)/2 - R_1$ Formula I

$U' = N_1N_2 + N_2(N_2 +1)/2 - R_2$ Formula II

$U = 16 X10 + 16 X(16 + 1) /2 - 235.5$

$= 60.5$

$U' = 16 X10 + 10 X(10 + 1) /2 - 115.5$

$= 99.5$

We can check that $U + U' = N_1N_2$

Step 5: Now we have to use Table for the critical value of U to reject or accept the null hypothesis.

In the Table find N_L (larger group) = 16 and N_S (smaller group) = 10 at the 0.05 level. The critical value of U from the Table is 48.

The computed *smaller value* of U is 60.5 (please note that the other value of U is 99.5 which is greater than 60.5).

The smaller value of U is larger than the critical value of U i.e. 48. Hence the null hypothesis is accepted.

Thus we may conclude that both the groups do not differ in terms of the distribution of intelligence on account of the environmental influences.

Procedure for the U test for small samples

Small sample means when neither the number of cases in the two independent samples are greater than 8.

The Steps for calculating U for small samples are described taking a suitable example as follows:

Let us suppose there are two independent samples A and B with 4 and 5 cases. We have to establish that both samples have been drawn from the same population.

Scores of Sample A: 8,6,10,5

Scores of Sample B : 9,7,11,8,12

Step 1: *Setting the hypothesis and level of significance:*

Null hypothesis : There is no significant difference between the distribution of the scores of sample A and sample B

Level of significance: 0.05

Step 2: The process of combining the scores of the two samples and ranking them in ascending order while maintaining their identity as scores of A scores of B will provide the following arrangement:

Scores:	*5*	*6*	*7*	*8*	*8*	*9*	*10*	*11*	*12*
Sample:	*A*	*A*	*B*	*A*	*B*	*B*	*A*	*B*	*B*

Step 3: To determine U by counting how many scores from sample A precede each score of sample B.

i) For B score 7, No. of A scores preceding it = 2

ii) For B score 8, No. of A scores preceding it = 2 (one is equal)

iii) For B score 9, No. of A scores preceding it = 3

iv) For B score 11, No. of A scores preceding it = 4

v) For B score 12, No. of A scores preceding it = 4

Therefore U = 2 + 2+ 3 + 4 +4 =15

Step 4: To determine U by counting how many scores from sample B precede each score of sample A.

i) For A score 5, No. of B scores preceding it = 0

ii) For A score 6, No. of B scores preceding it = 0

iii) For A score 8, No. of B scores preceding it = 1

iv) For A score 10, No. of B scores preceding it = 3

Therefore U = 0 + 0+ 1 + 3 = 4

Step 5: We have to make use of lower value of U i.e. 4 for testing null hypothesis.

From the Table, the critical value of U for N_L (larger group of 5 scores) and N_S (smaller group of 4 scores) is 0.008. But our computed value of U is 4, which is larger than the critical value. Thus the null hypothesis is accepted and we conclude that both the samples are drawn from the same population.

3.5.8 Kruskal – Wallis Test

Kruskal – Wallis test is a non parametric test based on the ranks of data; the actual values of data are not used here. Some times it is called one-way ANOVA on ranks. This test determines whether the medians of two or more groups are different. The test statistic used in this test is called the H statistics. Using this test one can find out if there is a significant difference between groups; but it cannot determine which groups are different.

Basic Assumptions of Kruskal-Wallis test are:

i) The independent variable will have two or more levels. This test is commonly used when the independent variable has three or more levels. For two levels Mann Whiteny U test should be considered. That's why this test is also known as extended form of Mann Whiteny U test.
ii) Dependent variable will be in Ordinal, Interval or Ratio scale.
iii) There will be no relationship within group or between the groups, that means the observations should be independent.

Example of Kruskal- Wallis test:

There are three types of workers in a company. The salaries of the workers are given below:

Type I: 20000, 30000, 25000, 32000, 22000, 40000

Type II: 28000, 36000, 19000, 35000, 21000, 31000

Type III: 23000, 37000, 29000, 24000, 27000, 38000

To know if three types of workers have different salaries we have to run Kruskal-Wallis test.

The steps of the test are given below:

Step 1: Sort the data for all workers into ascending order in one combined set.

19000, 20000, 21000, 22000, 23000, 24000, 25000, 27000, 28000, 29000, 30000, 31000, 32000, 35000, 36000, 37000, 38000, 40000

Step 2: Assign ranks to the sorted data points.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

(Note: Here there is no tied values. For ties values average rank should be given.)

Step 3: Add up the different ranks for the salaries of each Type of workers:

Type I: 2 + 11 + 7 + 13 + 4 + 18 = 55

Type II: 9 + 15 + 1 + 14 + 3 + 12 = 54

Type III: 5 + 16 + 10 + 6 + 8 + 17 = 62

Step 4: Calculate H:

$$H = [\ 12 / n\ (n+1) \sum T^2 / m\ ] - 3(n+1)$$

Where, n = Total no. of samples

T = sum of ranks of each levels of independent variable

m = size of the sample in each level.

In this problem, $n = 18$, $T_1 = 55$, $T_2 = 54$, $T_3 = 62$, $m_1 = m_2 = m_3 = 6$

So, $H = 12/(18 \times 19) \times [\ 55^2 / 6 + 54^2 / 6 + 62^2 / 6\ ] - 3 \times 19$

$= 12/ 342 \times (9785/6) - 57 = 57.22 - 57 = 0.22$

Step 5: Find the critical chi-square value with $3 - 1 = 2$ degrees of freedom

At 0.05 level, for df = 2, the critical value of chi square is 5.991.

Step 6: Compare H value with the critical chi square value:

Here, calculated value of H is much less than critical chi square value at 0.05 level. So we have to accept null hypothesis that median salary of each type of workers is equal.

3.6 Computer Application for analysis

It is the age of computer and technology. Computers have wide applications almost in all spheres. In all types of research the researchers are using computers for many purposes.

Computer has become one of the useful research tools not only in science but also in behavioural science, even in humanities.

In education and psychology the use of computer is increasing day by day. Computer can perform many statistical calculations easily and very quickly. Computations of means, standard deviations, coefficient of correlation, t-test, ANOVA, ANCOVA, regression analysis, factor analysis and various non-parametric analyses are done by the computer very easily and correctly using specific software. There are many software available for the statistical analysis of data. Some popular software are SPSS (Statistical Package for the Social Sciences), SAS (Statistical Analysis System), Minitab and many others. SAS offers a number of descriptive statistics programs. For example SAS: CORR is used for the correlations, SAS- Chart is used for sophisticated graphics. For different graphics SPSS-X is also a popular program. Even using Excel one can compute many statistical quantities.

For the analysis of statistical data using a computer following steps should be followed:

i) Data organizing and coding
ii) Storing the data in the computer system
iii) Selection of appropriate descriptive and inferential statistics
iv) Selection of appropriate programs for the desired statistics
v) Writing of control cards
vi) Execution of the computer programs.

The selection of appropriate statistics generally depends on the design of the study, and the specific program to be used depends upon the researcher's preference.

3.7 Tabulation and Graphic representation

Data is a set of values of qualitative or quantitative variables. In psychology and Education we get data from different tests, experiments & Surveys. These data are mainly numerical. When thse data are collected in original form, they have little meaning for the investigator. For interpretation of the data so collected and for deriving conclusion data, have to be organized or arranged in a Systematic way. There are many ways for the organisation of data. For example :

i) Organisation of data in the form of rank order
ii) Organisation of data in the form of frequency distribution

3.7.1 Rank order :

We obtain data from tests, experiments, Survey Studies in education and psychology and these data are mostly in numerical sores. These original raw scores can be successfully arranged in an ascending or descending series exhibiting an order with respect to the rank or merit position. For clarification of this procedure let us take an example.

Example : The achievements scores of 50 Students of Class IX are as follows :

174, 170, 165, 176, 190, 166, 137, 172, 165, 180, 178, 181, 167, 171, 157, 169, 140, 176, 177, 137, 184, 175, 169, 165, 172, 181, 182, 168, 148, 135, 183, 175, 192, 162, 172, 155, 187, 158, 156, 142, 179, 187, 179, 160, 176, 152, 156, 150, 180, 145.

If we tabulate this data in the form of a rank order (from highest scores to lowest scores i.e. in descending order) then it will look like below:

SI. no.	Scores	SI. no.	Scores	SI. no.	Scores
1	192	18	176	36	160
2	190	19	175	37	158
3	187	20	175	38	157
4	187	21	174	39	156
5	184	22	172	40	156
6	183	23	172	41	155
7	182	24	172	42	152
8	181	25	171	43	150
9	181	26	170	44	148
10	180	27	169	45	145
11	180	28	169	46	142
12	179	29	168	47	140
13	179	30	167	48	137
14	178	31	166	49	137
15	177	32	165	50	135
16	176	33	165		
17	176	34	165		
		35	162		

3.7.2 Frequency Distribution :

When we organise data in the form of rank order it does not tell us the number of times the score is repeated (which we call 'frequency') in the given Series. When we handle large number of data then it needs to be adequately Summarized for proper presentation and interpretation. For Summarization of large number of data it is very much esential to group the data into some arbitrary classes or groups and to find out the frequencies of the groups. Such type of organization of data is called frequency distribution.

Frequency distribution of data is carried out through systematic steps. To understand the Steps clearly let us take the data of achievement sources of 50 Students of class IX (already discussed in the Section of rank order).

Step I : Finding the range :

Range is the difference between the highest score and the lowest score in a distribution. In the achievement score of the Students higher score is 192 and the lowest score is 135.

$\therefore$ Here, range = 192–135 = 57

Step II : Determining Class interval

Class interval is the size of the class. To organize the data in a frequency distribution, we have to desire the number of class or groups. It is generally done by knowing the range of data. Thus,

$$\text{Class interval (i)} = \frac{\text{Range}}{\text{No. of Class desired}}$$

Generally the class interval is taken as 2, 3, 5 or 10. In the Present data if we take class interval as 5, then the number of classes will be $\frac{57}{5}$ = 11.4 i.e. the nearest whole number = 12.

So, if we form 12 number of classes with class interval 5, then the desired classes will be 135–139, 140–144, 145–149, 150–154, 155–159, 160–164, 165–169, 170–174, 175–179, 180–184, 185–189 and 190–194.

Step III : Construction of the frequency distribution table

In this step a table is constructed having three columns. In the first column, all

classes of the distribution is written down. In the 2nd column, the tally marks of each class is written. Tally marks is nothing but the number of times occuring a score in the given class. For example, in the class 135-139, the number of scores is 3. So the tally mark will be III.

In the 3rd column of the table, the frequencies of each class is written.

This step will be understood better from the following frequency distribution table.

Table : Frequency distribution table

Classes of Scores	Tallies	frequencies
190–194	II	2
185–189	II	2
180–184	𝍸 II	7
175-179	𝍸 IIII	9
170-174	𝍸 I	6
165–169	𝍸 III	8
160–164	II	2
155–159	𝍸	5
150–154	II	2
145–149	II	2
140–144	II	2
135–139	III	3
		N = 50

3.7.3 Graphical Representation of data:

We know that presentation of data is very important. In earlier section we have discussed the organisation of data and presentation of them by tables. We will now discuss about the graphical representation of data. A graphical representation of data is the geometrical picture of a set of data. It is well said that one picture is better than thousand words because graphic representation of data is quite effective for understanding and interpretation of data.

- **Graphical representation of ungrouped data:**

Ungrouped data are the data in the form of raw scores and grouped data are those when they are organized into a frequency distribution.

For ungrouped data generally following graphical representations are used.

(a) Bargraph or bar diagram

(b) Pie diagram or circle graph

(c) Pictogram

(d) Line graph

Bar graph or bar diagram :

In this graph the data is represented by bars. The bars are drawn either vertically or horizontally. The bars are rectangles having small width. The length or height of the bar is Propartional to the amount of variables. The space between two bars remains same. We can understand the bar graph clearly through an example.

Example : The number Students in different classes of a School is given below.

Class	No. of Students
VI	160
VII	120
VIII	100
IX	80
X	60

If we represent the above data though a bar graph then it will look like this :

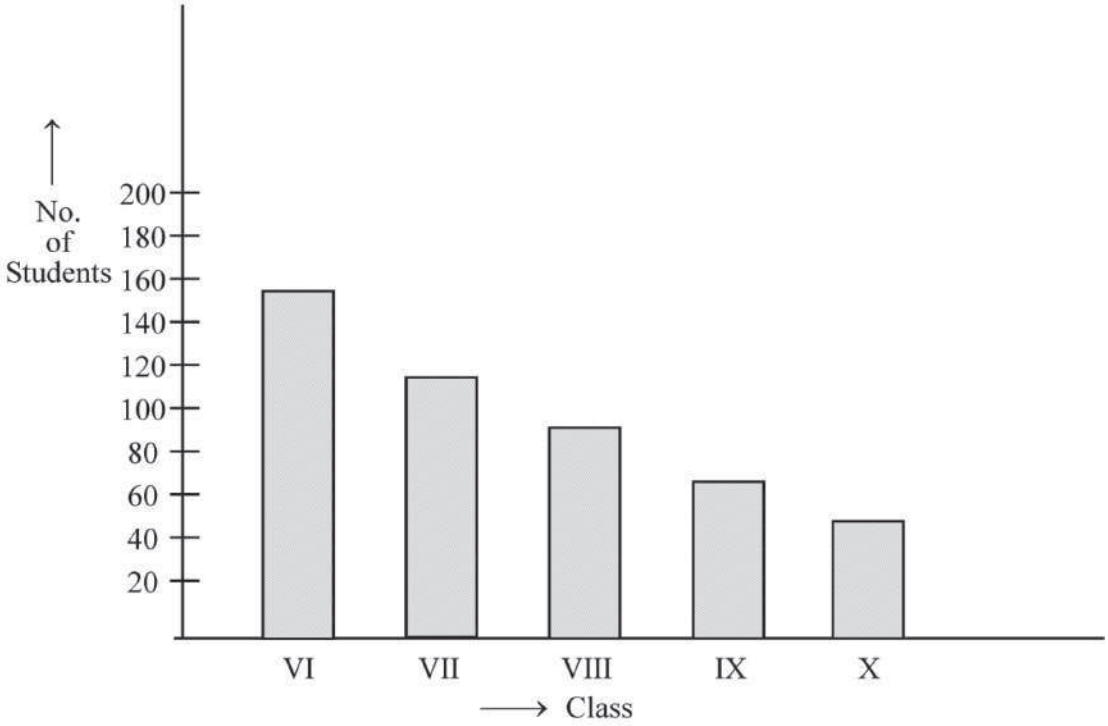

Figure : Bar graph

Here we have drawn the bars vertically. But Some times we draw the bars horizontally.

Pie diagram or Circle Graph :

In circle graph or pie diagram, data are represented by the Sections or portions of a circle. We know that the total angle Subtended by a circle at its centre is 2π or 360°. This total angle 360^{0} is divided among the variables according to their amounts. After determining these angles, the required Sectors in the circles are drawn.

For illustration of pie diagram or circle gaph let us take an example.

Example : Given below are the Seats won by different political parties in the Polling outcome of a state assembly elections.

Political party :	A	B	C
No. of Seats won :	90	30	60

To draw the pie diagram of the above data we have to first determine the angle of the circle occupied by each datum.

Political Party	Seats won	Angle of the Circle
A	90	$\frac{90}{180} \times 360^{\circ} = 180^{\circ}$
B	30	$\frac{30}{180} \times 360^{\circ} = 60^{\circ}$
C	60	$\frac{60}{180} \times 360^{\circ} = 120^{\circ}$
	Total 180	Total 360°

Now the pie diagram of the above data will look like this :

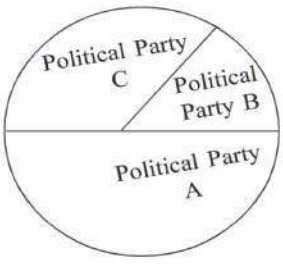

Figure : Pie diagram

• Graphical representation of grouped data :

When data are organized in to a frequency distribution, then its called grouped data.

Generally following methods are used for representation of frequency distribution graphically.

(a) The Histogram

(b) The frequency Polygon

(c) The Cumulative frequency Polygon

(d) The Cumulative frequency Percentage curve or ogive.

Histogram :

Histogram is a bar graph of frequency distribution. While constructing the histogram the scores in the form of actual class limits are taken. Two extra intervals one below and the other above the given grouped interval with zero frequency are taken. Let us take an example for illustration.

Example :

Scores	frequency
70-74	2
65-69	4
60-64	5
55-59	6
50-54	7
45-49	11
40-44	9
35-39	3
30-34	2
25-29	1

Here the actual class limits are 24.5–29.5, 29.5–34.5 and So on. We can take two extra classes 19.5–24.5 in the lower side and 74.5–79.5 in the upper side with zero frequencies.

Now the actual lower lower limits of all the class intervals are Plotted on the X-axis and the respective frequencies are plotted on the Y-axis. The base of each rectangle is the width of the class interval (i) and the hight is the respective frequency of that class. The units along X axis and Y axis are so chosen that the height of the figure is approximately 75% of its width. (It is a general rule).

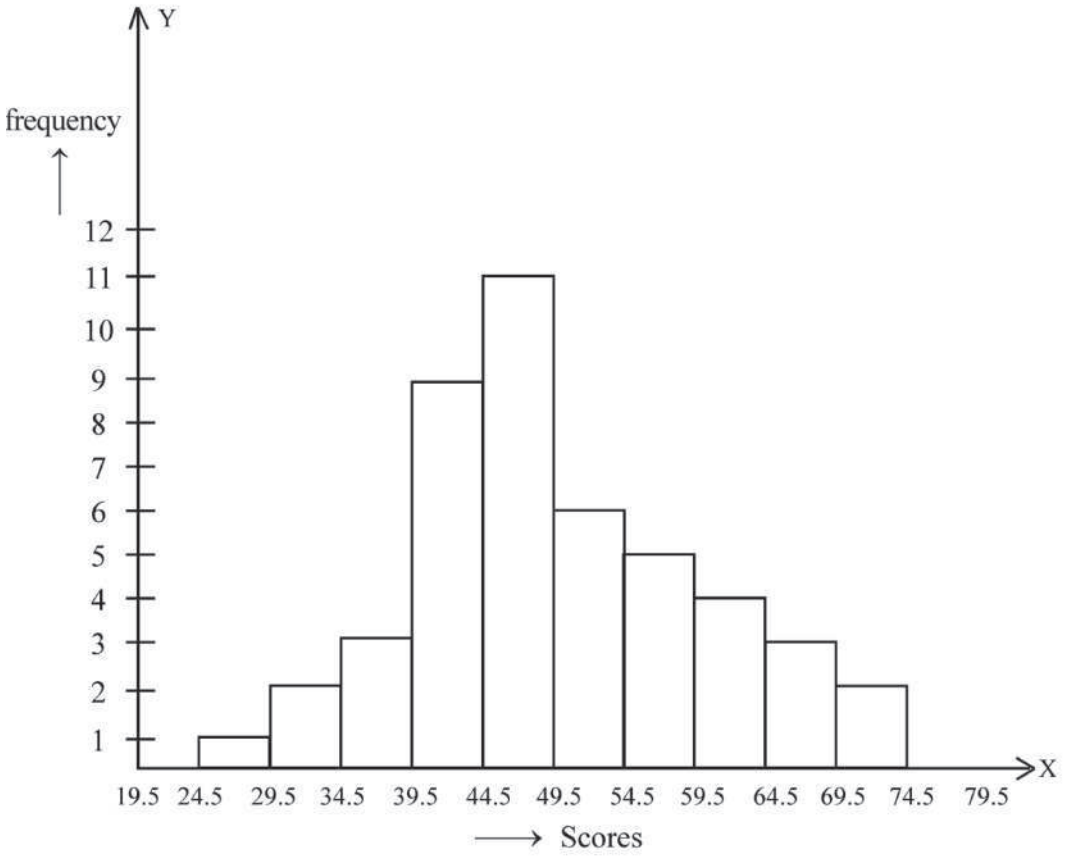

Figure : Histogram of frequency distribution

Frequency Polygon :

We have seen than a histogram is a bar graph; but a frequency polygon is a line graph for the graphical representation of the frequency distribution. To construct a frequency Polygon we have to follow the following steps :

(i) Two extra classes, one below and one above the given intervals are taken (as in the case of histogram).

(ii) The mid points of all classes are calculated and marked along the X-axis

(iii) The Corresponding frequencies are Plotted along Y-axis

(iv) The Points thus obtained by Plotting the midpoints and the corresponding frequencies are joined by straight lines. This gives the required frequency polygon.

Here also the scales of X-axis and Y-axis should be chosen in such a way that the height of the polygon is approximately equal to the 75% of the width.

We can have the frequency polygon from a histogram. Here we have to connect the midpoints of the upper bases of the rectangles by straight lines.

In the next Section a frequency polygon is constructed directly from a frequency distribution. We will take the same frequency distribution as taken in case of histogram. In this frequency distribution the midpoints are 22, 27, 32, 37, 42, 47, 52, 57, 62, 67, 72 & 77. The corresponding frequencies are 0, 1, 2, 3, 9, 11, 7, 6, 5, 4 2 & 0

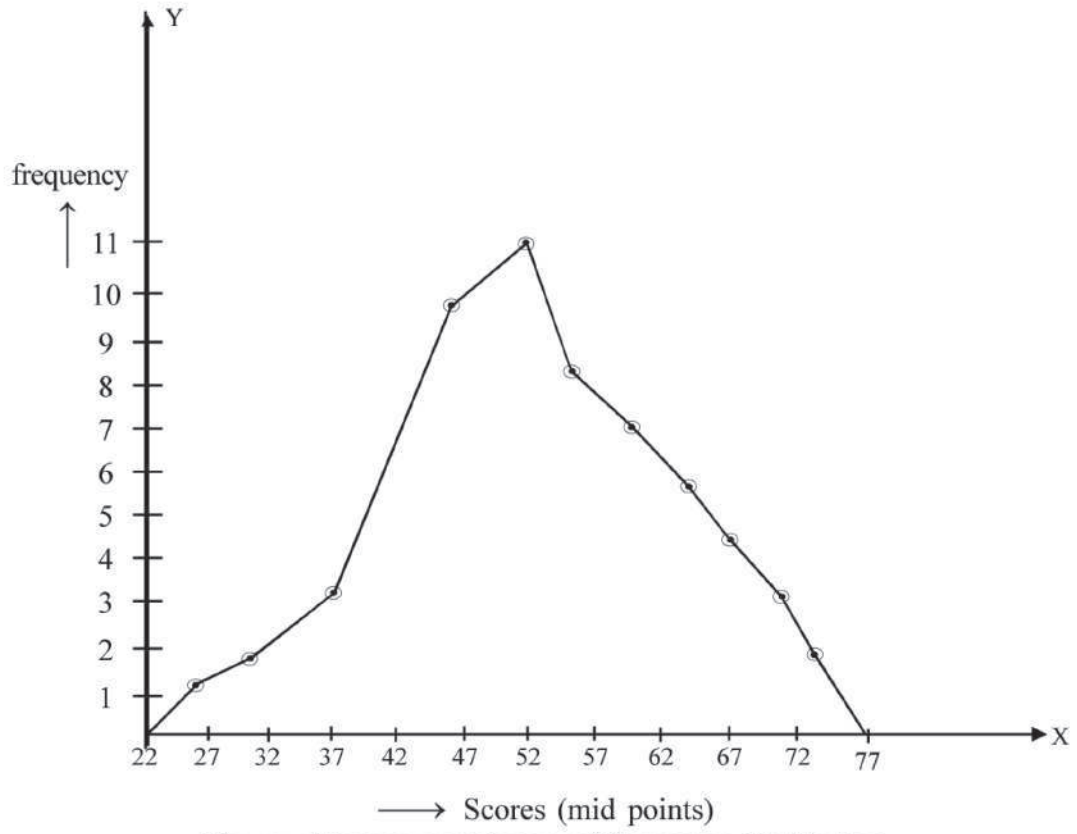

Figure : Frequency polygon of frequency distribution

Cumulative frequency graph

Cumulative frequency graph is also a line graph like frequency polygon. But in this case the data organized in the form of cumulative frequency distribution is Plotted. The actual upper limits of the class intervals are Plotted on the X-axis and the respective cumulative frequencies are plotted on the Y-axis. All the plotted points are then joined through a Successive chain of Straight lines which results a line graph. Here also it is customary to take one extra class interval with zero cumulative frequency to plot the origin of the curve on the X-axis. Let us take an example of frequency distribution to plot the cumulative frequency graph. Here we take the same frequency distribution as taken for plotting histogram or frequency polygon.

Example :

Scores	actual upper limit	frequency	comulative frequency	cumulative percentage frequency
70-74	74.5	2	50	100
65-69	69.5	4	48	96
60-64	64.5	5	44	88
55-59	59.5	6	39	78
50-54	54.5	7	33	66
45-49	49.5	11	26	52
40-44	44.5	9	15	30
35-39	39.5	3	6	12
30-34	34.5	2	3	6
25-29	29.5	1	1	2
20-24	24.5	0	0	0

To Plot origin of the curve we take an extra class interval 20-24 with zero frequency.

So in the above example we plot first the actual upper limits 24.5, 29.5, 34.5, 39.5, 44.5, 49.5, 54.5, 59.5, 64.5, 69.5 and 74.5 on the X-axis and then the corresponding cumulative frequencies o, 1, 3, 6, 15, 26, 33, 39, 44, 48 and 50 along Y-axis.

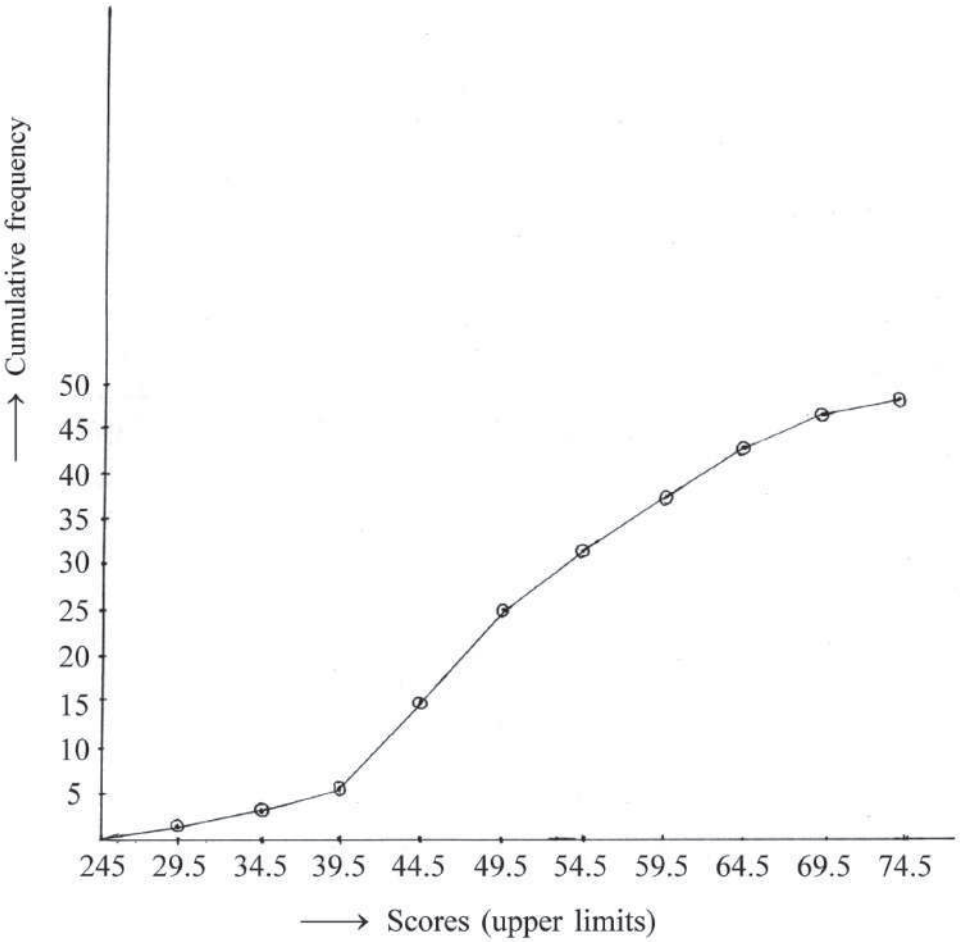

Figure : Cumulative frequency curve.

Cumulative Percentage frequency curve or Ogive

Cumulative Percentage frequency curve or Ogive is another way of graphical representation of frequency distribution. As in the case of cumulative frequency curve here also the actual upper limits of the class intervals are plotted on the X-axis and to take the origin of the X-axis here also we consider another class interval with zero frequency. The respective cumulative percentage frequencies are plotted along Y-axis. The general rule for consideration of Scales of X-axis and Y-axis is same i.e. scales are so chosen that height of the curve is approximately 75% of the width of the curve.

If we consider the same frequency distribution as taken for plotting the cumulative frequency curve, then we see that the upper class limits are 24.5, 29.5, 34.5, 39.5, 44.5, 49.5, 54.5, 59.5, 64.5, 69.5 and 74.5 and the corresponding cumulative percentage

frequencies are 0, 2, 6, 12, 30, 52, 66, 78, 88, 96 and 100. The ogive of this frequency distribution will be as follows :

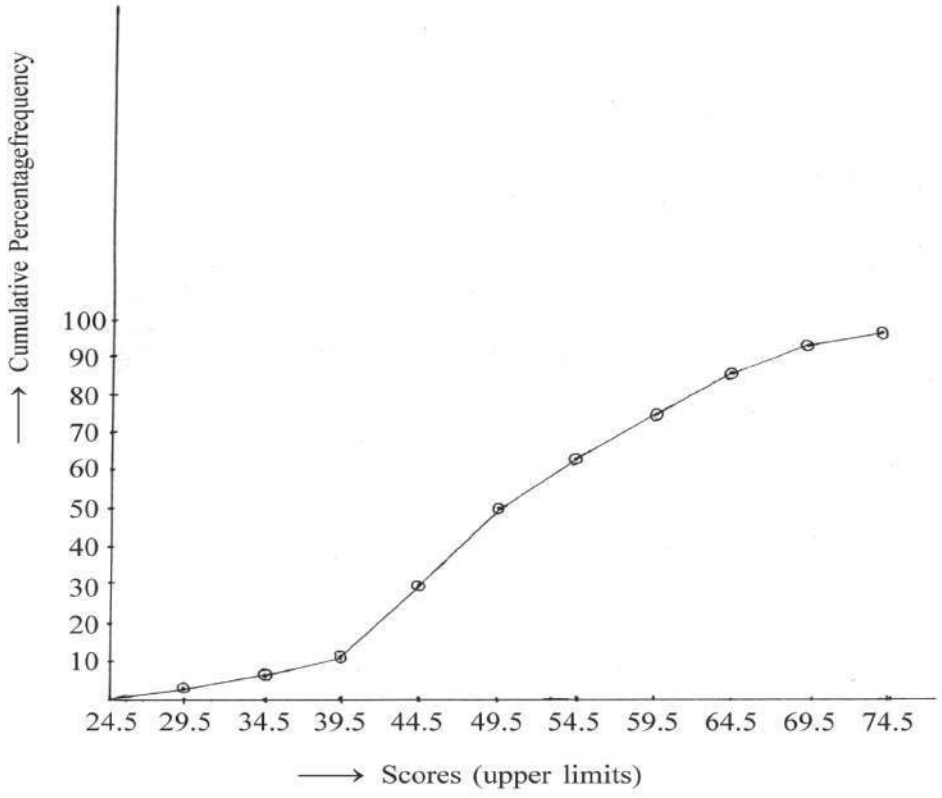

Figure : Ogive or Cumulative Percentage frequency curve

It is to be noted that Ogive or Cumulative Percentage frequency curve is very useful in Statistics. We can determine median, quartile, quartile deviations, deciles, percentiles, percentile ranks very accurately and fairly from ogive. Ogive can also be used for over all comparison of two or more frequency distributions by plotting the curves on the same Co-ordinate axes. Another important point is to be mentioned that ogive or other frequency curves sometimes need to be Smoothed. One of the methods of Smoothing a frequency distribution is the method of "running average". The formula for this method is as follows :

Smoothed frequency of a class interval

$= \frac{1}{3}$ [Frequency of the given class interval + frequencies of the two andjacent cl intervals].

3.8 Let us sum up

This unit deals with the different ways of presentation of data of educational research graphically and focuses mainly on the different types of statistics used for the analysis of these data. Data in the field of education and psychology are mostly numerical and for interpretation of the data suitable statistics should be used. In this unit different descriptive statistics like central tendencies (mean, median, mode), different correlations, regression etc are described with suitable examples. The central tendencies provide us a central value of a set of scores as a whole. In education we need to know whether there exists any relationship among the different attributes and this can be fulfilled by measuring coefficient of correlation. But in most of the data the correlation are hardly found to be perfect. Therefore for reliable prediction we use regression analysis.

The main purpose of inferential analysis is to draw out conclusions about populations based on observations of samples. For this there are different types of parametric and non-parametric tests. Parametric tests include t-test (two know the significant difference between two means), ANOVA (two know the significant difference among more than two means), ANCOVA (an extended method of ANOVA to find the correlation between initial and final scores) etc. Among the non-parametric tests most common test is chi-square (used to test how well the data obtained experimentally fit in the results expected theoretically). There are many other non-parametric tests like sign test (for comparing two correlated samples using only plus and minus signs), Mann-Whiteny U test (non-parametric alternative to the t-test), Kruskal-Wallis test (based on the ranks of data, the actual values of data are not used) etc. For statistical analysis of data use of computer is increasing day by day. Many modern and more sophisticated software like SPSS, SAS, Minitab etc are available now for this purpose.

3.9 Unit end exercises

1. Compute the mean, median and mode for the following distributions:

Scores:	81-85	76-80	71-75	66-70	61-65	56-60	51-55	46-50
Frequency:	8	9	10	14	16	12	7	4

2. What is Pearson's Product Moment method of computing correlation?

3. Find out the coefficient of correlation between the following two sets of scores using product moment method.

Individuals :	A	B	C	D	E	F	G	H	I	J	K	L
Variable X :	11	14	16	18	20	19	18	14	16	22	24	20
Variable Y:	42	39	40	35	37	41	42	36	38	39	46	48

4. What is histogram? How does it differ from a frequency polygon?

5. What is Regression equation?

6. What is the difference between Type I error and Type II error?

7. A dice is tossed 120 times and the three-spot face appears the top 30 times. Test the hypothesis using suitable statistics that the dice is unbiased.

8. What is t-test? The following data were collected from two separate groups of 130 men and 140 women on an attitude scale.

	Mean	SD
Men	20.5	5.8
Women	21.8	4.6

Test the significance of the difference between the mean of two groups at 0.05 level of significance.

9. What is ANOVA? How it does differ from ANCOVA?

10. What is sign test? Discuss its application procedure with the help of an example.

11. Analyse the process of Mann-Whiteny U test (with suitable example) for testing the difference between two population distributions.

12. How does Kruskal-Wallis test differ from Mann-Whiteny U test?

13. Write a note on application of computer in statistics.

14. What is confidence level?

15. What is meant by degrees of freedom?

3.10 References

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Unit - 4 □ Qualitative Research Methods and Analysis

Structure

4.1 Introduction

Qualitative research is a process of exploring the potential antecedents and factors about which little has been known and explored (Strauss & Corbin, 1998). Qualitative research is based on three paradigms and main paradigms within the qualitative research are positivistism, interpretivistism, and post-positivistism (Punch, 1998). Neuman, defined paradigm as…

> 'A paradigm is a framework or a set of assumptions that explain how the world is perceived where 'the paradigm of a science includes its basic assumptions, the important questions to be answered or puzzles to be solved, the research techniques to be used, and examples of what scientific research looks like'(Neuman, 1991).

Kuhn (1970) is famous as a first researcher for using paradigms in the context of a framework to understand inquiry. He sees paradigms as…

> 'A set of values and techniques which is shared by members of a scientific community, which act as a guide or map, dictating the kinds of problems scientists should address and the types of explanations that are acceptable to them'(Kuhn, 1970).

These paradigms are further based on three perspectives. These perspectives are epistemology, ontology and methodology (Denzin& Lincoln, 2003; Punch, 2013). The epistemological perspective is concerned with the way knowledge is acquired. It totally depends upon the relationship between researcher and how the researchers perceive that reality (Creswell, 2007; Gratton & Jones, 2004; Punch, 1998). Ontology is concerned with the nature of reality. The reality is perceived as subjective and depends how researchers and participants perceive it (Creswell, 2007; Punch, 1998). Methodology is concerned with process and method through which the researcher acquires knowledge about the world (Creswell, 2007; Edwards & Skinners, 2009; Punch, 1998, 2013).

The core property of qualitative research is that it examines the way people make sense out of their own concrete real-life experiences in their own minds and in their own words. This information is usually expressed in everyday language using everyday concepts. Qualitative research thus contrasts with quantitative research, which focuses on the way the world is understood in researchers' minds, usually using abstract scientific concepts and terminology. Quantitative research also examines differences in amount or level of the variables being studied and cause and effect relationships among them, whereas qualitative research is concerned with the patterns and forms of such variables. Qualitative methods are regarded as offering a legitimate method for gaining information about and understanding how human beings function. Although qualitative research was out of fashion for a long time, modern interest in it represents the re-emergence of an approach that has as long a history in social science as quantitative methods. Despite the existence of "paradigm wars," the two approaches are not rivals but are complementary.

Every research must involve an explicit, disciplined, systematic (planned, ordered, and public) approach to find out most appropriate results. Qualitative research is inductive in nature, and the researcher generally explores meanings and insights in a given situation (Strauss & Corbin, 2008; Levitt et al., 2017). It is described as an effective model that occurs in a natural setting and enables the researcher to develop a level of detail from high involvement in the actual experiences (Creswell, 2009). It is a type of social science research that collects and works with non-numerical data that seeks to interpret meaning from these data that help us to understand social life through the study of targeted populations or places (Punch, 2013). It is the observations and interpretations of people's perception of different events, and it takes the snapshot of the people's perception in a natural setting (Gentles et al., 20150. It investigates local knowledge and understanding of a given program, people's experiences, meanings and relationships, and social processes and contextual factors that marginalize a group of people. It is less structured in description, because it formulates and builds new theories (Leedy & Ormrod, 2001). Qualitative research is a form of social action that stresses on the way of people interpret, and make sense of their experiences to understand the social reality of individuals. It makes the use of interviews, diaries, journals, classroom observations and immersions; and open-ended questionnaires to obtain, analyze, and interpret the data content analysis of visual and textual materials, and oral history (Zohrabi, 2013). It is exploratory, and seeks to explain 'how' and' why' a particular social phenomenon, or program, operates as it does in a particular context.

It tries to help us to understand the social world in which we live, and why things are the way they are (Polkinghorne, 2005).

Qualitative research comprises of the following methods: logic, ethnography, discourse analysis, case study, open-ended interview, participant observation, counseling, therapy, grounded theory, biography, comparative method, introspection, casuistry, focus group, literary criticism, meditation practice, historical research, etc. (Cibangu, 2012). The purpose of qualitative research is to describe and interpret issues or phenomena systematically from the point of view of the individual or population being studied, and to generate new concepts and theories. The choice of methodology is directed by the questions being raised (Viswambharan & Priya, 2016).

4.2 Objectives

- Students will be able to understand what qualitative research is all about.
- They will familiarise them with specialized terminology related to qualitative research.
- They will be able to explain what they are doing and why.
- They will be able to show how qualitative research meets standards of scientific rigour.
- They will know how to conduct and write up such research.

4.3 Grounded theory

4.3.1 Introduction

The qualitative research approach 'grounded theory' has been developed by two sociologists, Barney Glaser &Anselm Strauss (Glaser, 1978, 1992; Glaser & Strauss, 1967, 2009; Strauss, 1987). They defined 'grounded theory' in these words as 'The theory that was derived from data, systematically gathered and analyzed through the research process' (Strauss & Corbin, 1990).Grounded theory is all about data collection and analysis.

In this approach the aim is to construct a theory that is grounded in the data (Glaser, 1978, 1992; Glaser & Strauss, 1967, 2009; Strauss, 1987). According to Glaser (1992) grounded theory deals with only inductive approach rather than deductive approach of inquiry. Further, (Punch, 1998) defined the grounded theory approach very briefly in these words as…

'Grounded theory is not a theory at all. It is a method, an approach, a strategy. In my opinion, grounded theory is best defined as a research strategy whose purpose is to generate theory from data. 'Grounded' means that the theory will be generated on the basis of data; the theory will therefore be grounded in data. 'Theory' means that the objective of collecting and analyzing the research data is to generate theory. The essential in grounded theory is that theory will be developed inductively from data'.

The grounded theory approach is basically a step towards conceptual thinking and theory building rather than empirical testing of the theory. Hence, a qualitative research approach is used in these types of studies. Particularly it is conceptual thinking and theory building that's why the researchers usually are going to conduct an inductive, constructivist 'Grounded Theory' approach. As it is the systematic development of theory in social settings and it depends upon inductive approaches which is appropriate for the study mainly aim on theory development (Glaser & Strauss, 1967).

4.3.2 Evolution of Grounded Theory

Since the grounded theory development in 1967 by Glaser & Strauss, it's in the process of amendments by its instigators and others academic researchers for the last four decades. This theory is further split into two versions' by its originators and that is called the Glaser's version (Glaser, 1978, 1992) and that of (Strauss, 1987; Strauss & Corbin, 1990, 1998) version. Glaser kept on focusing on the earlier concept and remained consistent with it, the one he discovered with the Strauss. They defined grounded theory as '…a method of discovery, treated categories as emergent from the data, relied on direct and, often, narrow empiricism, and analyzed a basic social process'. Strauss (1987) moved the method towards verification, rather than focused on the earlier version of grounded theory. Despite a lot of criticism, (Strauss, 1987; Strauss & Corbin, 1990, 1998) version of grounded theory is more famous than the earlier version of grounded theory. Their book serves as a powerful tool for conducting grounded theory approach and has instructed graduates students all over the world (Charmaz, 2014).He, Charmaz (2006, pp. 5-6)further mentioned in his book rather cited the (Glaser, 1978; Glaser & Strauss, 1967; Strauss, 1987) defining components of grounded theory practice in these words as…

- 'Simultaneous involvement in data collection and analysis,
- Constructing analytic codes and categories from data, not from preconceived logically deduced hypotheses,

- Using the constant comparative method, which involves making comparisons during each stage of the analysis,
- Advancing theory development during each step of data collection and analysis,
- Memo-writing to elaborate categories, specify their properties, define relationships between categories, and identify gaps.
- Sampling aimed toward theory construction, not for population representativeness.
- Conducting the literature review after developing an independent analysis'.

He, Charmaz (2003) further summarized the grounded theory history, since its inception in 1967, in theappended below words…'What grounded theory is and should be is contested. Glaser and Strauss and Corbin have moved the method in somewhat conflicting directions (Glaser, 1992; Strauss, 1987; Strauss & Corbin, 1990, 1994, 1998). Glaser's(1978, 1992) position often comes close to traditional positivism, with its assumptions of an objective, external reality, a neutral observer who discovers data, reductionist inquiry of manageable research problems, and objectivist rendering of data. Strauss and Corbin's (1990, 1998) stance assumes an objective external reality, aims towards unbiased data collection, proposes a set of technical procedures, and espouses verification. Their position moves to post-positivism because they also propose giving voice to their respondents, representing them as accurately as possible, discovering acknowledging how respondents' views of reality conflict with their own, and recognizing art as well as science in the analytic product and process'.

The Strauss (1987) and Strauss and Corbin (1998) work turned the direction of grounded theory from positivist paradigm towards a more constructivist paradigm. This is best illustrated in the mentioned below paragraph by (Annells, 1996). 'A theory is not the formulation of some discovered aspect of a pre-existing reality 'out there'. To think otherwise is to take a positivist position…theories are interpretations made from given perspectives as adopted or researched by researchers. To say that a given theory is an interpretation – and therefore fallible – is not at all to deny that judgments can be made about the soundness or probably usefulness of it' While, Charmaz (2003) defined it in more detail and tried to differentiate between the true and real in grounded theory perspective…

‘A constructivist grounded theory distinguishes between the real and the true. The constructivist approach does not seek truth – single, universal, and lasting. Still, it remains realist because it addresses human realities and assumes the existence of real worlds…the constructivist approach assumes what we take as real, as objective knowledge and truth, is based upon our perspective…thus the grounded theorist constructs an image of reality, not the reality – that is, objective, true, and external’.

4.3.3 Research process

The grounded theory is ideal for exploring integral social relationships and the behaviour of groups where there has been little exploration of the contextual factors that affect individual’s lives (Crooks 2001). This theory is also used to get though and beyond conjecture and preconception to exactly the underlying processes of what is going on, so that professionals can intervene with confidence to help resolve the participant’s main concerns (Glaser 1978).

A well-developed outline of the study and an understanding of the important considerations in designing and undertaking the ‘grounded theory’ study are essential if the goals of the research are to be achieved. While it is important to have an understanding of how a methodology has developed, in order to move forward with research. Grounded theory research involves the meticulous application of specific methods and processes. Methods are ‘systematic modes, procedures or tools used for collection and analysis of data’. While the ‘grounded theory’ studies can commence with a variety of sampling techniques, many commence with purposive sampling, followed by concurrent data generation and/or collection and data analysis, through various stages of coding, undertaken in conjunction with constant comparative analysis, theoretical sampling and memoing. Theoretical sampling is employed until theoretical saturation is reached. These methods and processes create an unfolding, iterative system of actions and interactions inherent in the ‘grounded theory’. The methods interconnect and inform the recurrent elements in the research process as shown by the directional flow of the arrows and the encompassing brackets in Figure. The framework denotes the process is both iterative and dynamic and is not one directional. Grounded theory methods are discussed in the following section.

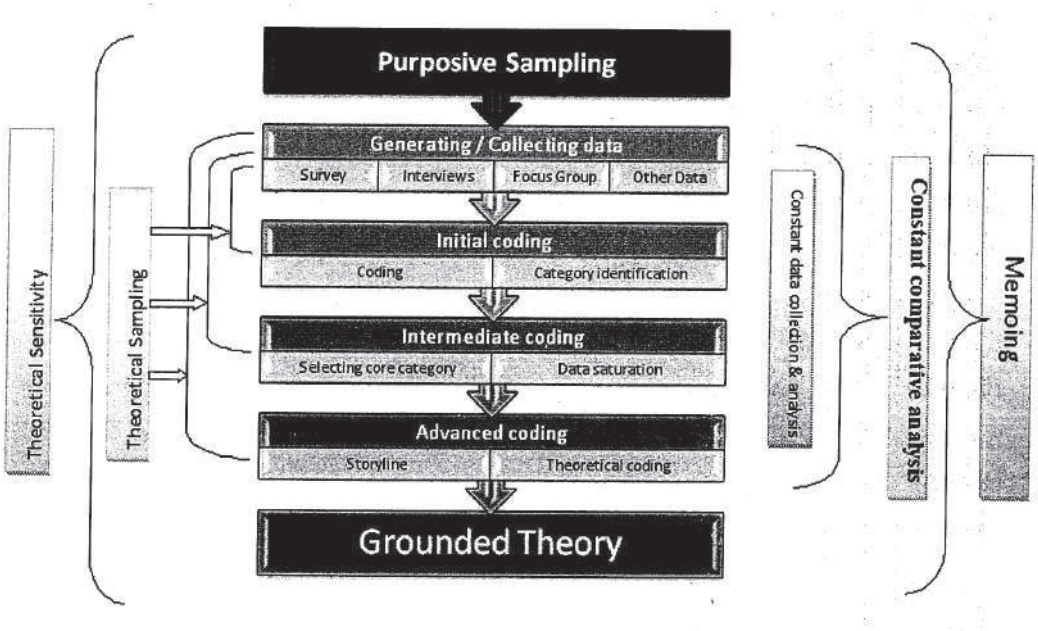

Figure 4.1: Schematic of research process of the 'Grounded Theory'

Purposive sampling: Researchers purposively select participants and/or data sources that can answer the research question. Concurrent data generation and/ or data collection and analysis are fundamental to the 'grounded theory' research design. The researcher collects codes and analyses this initial data before further data collection/generation is undertaken. Purposeful sampling provides the initial data that the researcher analyses Theoretical sampling is used to identify and follow clues from the analysis, fill gaps, clarify uncertainties, check hunches and test interpretations as the study progresses.

Constant comparative analysis: Constant comparative analysis is an analytical process used in the 'grounded theory' for coding and category development. This process commences with the first data generated or collected and pervadesthe research process. Incidents are identified in the data and coded. The initial stage of analysis compares incident to incident in each code. Initial codes are then compared to other codes. Codes are then collapsed into categories. This process means the researcher will compare incidents in a category with previous incidents, in both the same and different categories. Future codes are compared and categories are compared with other categories. New data is then compared with data obtained earlier during the analysis phases. This iterative process involves inductive and

deductive thinking. Inductive, deductive and abductive reasoning can also be used in data analysis.

The constant comparative technique is used to find consistencies and differences, with the aim of continually refining concepts and theoretically relevant categories. This continual comparative iterative process that encompasses the 'grounded theory' research sets it apart from a purely descriptive analysis.

Memoing: Memo writing is an analytic process considered essential 'in ensuring quality in grounded theory. Memos are the storehouse of ideas generated and documented through interacting with data. Thus, memos are reflective interpretive pieces that build a historic audit trail to document ideas, events and the thought processes inherent in the research process and developing thinking of the analyst. Memos provide detailed records of the researchers' thoughts, feelings and intuitive contemplations.

Lempert considers memo writing crucial as memos prompt researchers to analyze and code data and develop codes into categories early in the coding process. Memos detail why and how decisions made related to sampling, coding, collapsing of codes, making of new codes, separating codes, producing a category and identifying relationships abstracted to a higher level of analysis. Thus, memos are informal analytic notes about the data and the theoretical connections between categories. Memoing is an ongoing activity that builds intellectual assets, fosters analytic momentum and informs the 'grounded theory' findings.

Generating/collecting data: A hallmark of the 'grounded theory' is concurrent data generation/collection and analysis. In the 'grounded theory', researchers may utilize both qualitative and quantitative data as espoused by Glaser's dictum; 'all is data'. While interviews are a common method of generating data, data sources can include focus groups, questionnaires, surveys, transcripts, letters, government reports, documents, grey literature, music, artifacts, videos, blogs and memos. Elicited data are produced by participants in response to, or directed by, the researcher whereas extant data includes data that is already available such as documents and published literature. While this is one interpretation of how elicited data are generated, other approaches to grounded theory recognize the agency of participants in the co-construction of data with the researcher. The relationship the researcher has with the data, how it is generated and collected, will determine the value it contributes to the development of the final the 'grounded theory'. The significance of this relationship extends into data analysis conducted by the researcher through the various stages of coding.

Coding: Coding is an analytical process used to identify concepts, similarities and conceptual reoccurrences in data. Coding is thepivotal link between collecting or generating data and developing a theory that explains the data. According to Charmaz, Codes rely on interaction between researchers and their data. Codes consist of short labels that we construct as we interact with the data. Something kinesthetic occurs when we are coding; we are mentally and physically active in the process.

Coding terminology in evolved The 'Grounded Theory' refers to open (a procedure for developing categories of information), axial (an advanced procedure for interconnecting the categories) and selective coding (procedure for building a storyline from core codes that connects the categories), producing a discursive set of theoretical propositions. Constructivist grounded theorists refer to initial, focused and theoretical coding. Birks and Mills use the terms initial, intermediate and advanced coding that link to low, medium and high level conceptual analysis and development.

Initial coding: Initial coding of data is the preliminary step in The 'Grounded Theory' data analysis. The purpose of initial coding is to start the process of fracturing the data to compare incident to incident and to look for similarities and differences in beginning patterns in the data. In initial coding, the researcher inductively generates as many codes as possible from early data. Important words or groups of words are identified and labeled. In the 'Grounded Theory', codes identify social and psychological processes and actions as opposed to themes. Charmaz emphasizes keeping codes as similar to the data as possible and advocates embedding actions in the codes in an iterative coding process.

Initial coding categorizes and assigns meaning to the data, comparing incident-to-incident, labeling beginning patterns and beginning to look for comparisons between the codes. During initial coding, it is important to ask 'what is this data a study of'. What does the data assume, 'suggest' or 'pronounce' and 'from whose point of view' does this data come, whom does it represent or whose thoughts are they?. What collectively might it represent? The process of documenting reactions, emotions and related actions enables researchers to explore, challenge and intensify their sensitivity to the data. Early coding assists the researcher to identify the direction for further data gathering. After initial analysis, theoretical sampling is employed to direct collection of additional data that will inform the 'developing theory'. Initial coding advances into intermediate coding once categories begin to develop.

Theoretical sampling: The purpose of theoretical sampling is to allow the researcher to follow leads in the data by sampling new participants or material that provides

relevant information. Theoretical sampling is central to the 'Grounded Theory' design, aids the evolving theory and ensures the final developed theory is grounded in the data. Theoretical sampling in the 'Grounded Theory' is for the development of a theoretical category, as opposed to sampling for population representation. Birks and Mills define theoretical sampling as 'the process of identifying and pursuing clues that arise during analysis in a grounded theory study'. During this process, additional information is sought to saturate categories under development. The analysis identifies relationships, highlights gaps in the existing data set and may reveal insight into what is not yet known. Thus, theoretical sampling is used to focus and generate data to feed the iterative process of continual comparative analysis of the data.

Intermediate coding*:* Intermediate coding, identifying a core category, theoretical data saturation, constant comparative analysis, theoretical sensitivity and memoing occur in the next phase of the 'grounded theory' process. Intermediate coding builds on the initial coding phase. Where initial coding fractures the data, intermediate coding begins to transform basic data into more abstract concepts allowing the theory to emerge from the data. During this analytic stage, a process of reviewing categories and identifying which ones, if any, can be subsumed beneath other categories occurs and the properties or dimension of the developed categories are refined. Properties refer to the characteristics that are common to all the concepts in the category and dimensions are the variations of a property.

Advanced coding: Birks and Mills described advanced coding as the 'techniquesused to facilitate integration of the final grounded theory'. These authors promote storyline technique (described in the following section) and theoretical coding as strategies for advancing analysis and theoretical integration. Advanced coding is essential to produce a theory that is grounded in the data and has explanatory power. During the advanced coding phase, concepts that reach the stage of categories will be abstract, representing stories of many, reduced into highly conceptual terms. The findings are presented as a set of interrelated concepts as opposed to presenting themes. Explanatory statements detail the relationships between categories and the central core category. Storyline is a tool that can be used for theoretical integration. Birks and Mills define storyline as 'a strategy for facilitating integration, construction, formulation, and presentation of research findings through the production of a coherent grounded theory'. Storyline technique is first proposed with limited attention in Basics of QualitativeResearch by Strauss and Corbin and further developed by Birks et.al. as a tool for theoretical integration. The storyline is the conceptualization

of the core category. This procedure builds a story that connects the categories and produces a discursive set of theoretical propositions. Birksand Mills6 contend that storyline can be 'used to produce acomprehensive rendering of your grounded theory'.Birks et.al. had earlier concluded, 'storyline enhances the development, presentation and comprehension of the outcomesof grounded theory research'. Once the story lineis developed, the 'grounded theory' isfinalized using theoretical codes that 'provide a framework for enhancing the explanatorypower of the storyline and its potential as theory'. Thus, storyline is the explication of the theory. Theoretical coding occurs as the final culminating stagetowards achieving the 'grounded theory' andthe purpose of theoreticalcoding is to integrate the substantive theory.

Theoretical sensitivity: Thetheoretical sensitivity encompasses the entire research process. Glaser and Strauss5 initiallydescribed the term theoretical sensitivity in *The* Discovery ofGrounded Theory. Theoretical sensitivity is the ability toknow when you identify a data segment that is important to your theory. While Strauss and Corbin describe theoreticalsensitivity as the insight into what is meaningful and of significancein the data for theory development, Birks and Mills define theoretical sensitivity as 'the ability to recognizeand extract from the data elements that have relevancefor the emerging theory'. Conducting the 'grounded theory' researchrequires a balance between keeping an open mind and theability to identify elements of theoretical significance duringdata generation and/or collection and data analysis.

The meticulous application of essential the 'grounded theory' methods refines the analysis resulting in the generation of an integrated, comprehensive the 'grounded theory' that explains a process relating to a particular phenomenon. The results of the 'grounded theory' study are communicated as a set of concepts, related to each other in an interrelated whole, and expressed in the production of a substantive theory. A substantive theory is a theoretical interpretation or explanation of a studied phenomenon. Thus, the hallmark of grounded theory is the generation of theory 'abstracted from, or grounded in, data generated and collected by the researcher'. However, to ensure quality in research requires the application of rigour throughout the research process. The quality of a grounded theory can be related to three distinct areas underpinned by

(1) The researcher's expertise, knowledge and research skills;

(2) Methodological congruence with the research question; and

(3) Procedural precision in the use of methods.

Methodological congruence is substantiated when the philosophical position of the researcher is congruent with the research question and the methodological approach selected. Data collection or generation and analytical conceptualization need to be rigorous throughout the research process to secure excellence in the final grounded theory. Procedural precision requires careful attention to maintaining a detailed audit trail, data management strategiesand demonstrable procedural logic recorded using memos. Organization and management of research data, memos and literature can be assisted using software programs.

4.4 Ethnography and case study

4.4.1 Introduction

Qualitative researchers explore how people make sense of their world. A qualitative researcher seeks to define and interpret unclear phenomena through non-numerical methods of measurement that focus on meaning and insight. Exploratory research designs are conducted to clarify ambiguity and discover potential such as new product development as well as ideas for later research.

Ethnography is "the description and interpretation of a culture or social group" (Holloway et al., 2010, p. 76); it is an in-depth study of a culture and studies everyday behavior of participants. Ethnography began with the ancient Greeks and Romans in their descriptions of the Punic Wars and the Civil Wars (Holloway et al., 2010).Ethnography is a qualitative research design aimed at exploring the cultural interactions and meanings in the lives of a group of people (Barbour, 2010). For qualitative field research, ethnography involves learning the feelings, beliefs, and meanings of relationships between people as they interact within their culture or as they react to others in response to a changing phenomenon, for the research takes place within the culture being studied (Fields &Kafai, 2009). The researcher operates between multiple worlds engaging in research, which includes the cultural world of the study participants as well as the world of one's own perspective (Dibley, 2011). A researcher's cultural and experiential background will also contain biases, values, and ideologies that can affect the interpretation of a study (Bernard, 2012). It then becomes imperative that interpretation of the cultural phenomena represent that of participants and not of the researcher (Dibley, 2011). Hearing and understanding the perspective of others may be one of the most difficult dilemmas that face the researcher (Fields &Kafai, 2009). The better a researcher is able to recognize his/her personal view of the world and to discern

the presence of personal lenses, the better one is able to hear and interpret the behavior and reflections of others (Fields & Kafai, 2009).

A mini-ethnography, also known as a focused ethnography, is used when a field under investigation focuses on a specific or a narrow area of inquiry (White, 2009), particularly when time or monetary constraints are evident. Mini-ethnographies are prevalent within the medical field as well as marketing research and generally occur in less time than that of a full-scale ethnography (White, 2009) and range in time frames of weeks (Alfonso, Nickelson, & Cohen, 2012), to less than a year (Robillard, 2010; Sandall, 2010; Yang et al., 2011). The intent of mini-ethnography is for a researcher to understand the cultural norms, values, and roles as pertaining to what is remembered by participants (White, 2009) as opposed to phenomenology which addresses lived experience, grounded theory which identifies new theory to explain phenomenon, or content analysis which studies human communication including websites, newspapers, paintings, or books (Engward, 2013; Erlingsson&Brysiewicz, 2013).

Typically, the classic ethnographic study can take years to complete because the researcher must become enmeshed in the culture in order to obtain the type of data the researcher wants. Culture data is much more complex than one's usual data from a study. Traditional ethnography can take a great deal of time to accomplish, which is why it is not encouraged as a design choice for doctoral students (Storesund& McMurray, 2009). The time length (and finances to stay in the field) is probably why the mini-ethnography came into being (Storesund& McMurray, 2009). Mini-ethnographies can be conducted within a week, a month, or up to a year. Data saturation is somewhat relative with an ethnographic design depending on the length of the study because the study is typically on-going for a number of years. With a mini-ethnography, of course, data saturation is reached far sooner because he research is bounded in time and space by a case study design (Fusch, 2013).

Case study is an approach, which involves studying indi-vidual cases in their real life context for a long period of time. The case studied can be culture, society, community, organization or phenomenon, such as beliefs, practices or in-teractions (Harrison, Birks, Franklin, & Milles, 2017). The purpose of case study varies, depending on its type.

There are several types of case study. Yin (2003) states, this approach can be based on single or multiple case studies. Whether single or multiple, it can be exploratory, explanatory or descriptive. A single-case study emphasizes on a single case only, whereas multiple-case studies include two or more cases in the same study. An

exploratory case study attempts to define questions and hypotheses of a sub-sequent study, while an explanatory case study tries to ex-plain how particular phenomena happened. Here, data are presented, bearing on cause-effect relationships. A descrip-tive case study depicts a phenomenon completely within its context (ibid). Respondents are seen as experts not just as objects that inform or produce data and this approach studies a typical case, using a number of methods to prevent errors and distortions.

4.4.2 Ethnography and Ethnographic studies in Education

Heuristically, there are two ways of distinguishing among ethnographic studies focusing on education as a site for inquiry: (1) ethnography and ethnographic studies *of* education; and (2) ethnography and ethnographic studies *in* education. The first, prototypically involves anthropologists and sociologists using education as a place of study to which they bring theoretical frames, tools of inquiry, and a history from their field and discipline within the field to construct an understanding of what counts as education to a local group. From this perspective, educational sites, such as schools, are primarily physical sites that become locations for the pursuit of social science research through ethnography and ethnographic research. Theories, questions and goals of this research are framed by the home disciplines and academic fields of the researcher, and not necessarily by educator's needs, issues or concerns.

The second set, studies in education, can be heuristically defined as studies grounded in knowledge derived from the field of Education and the historical background of ethnography in anthropology and sociology. These studies, however, are guided by educational questions, purposes, needs and concerns, which, as argued previously, shape the specific character of ethnography in education. From this perspective, education is both a physical site and an intellectual one with its own knowledge base, questions and purposes. Ethnography in education is conducted by those inside this academic field, e.g., teachers, students, teacher educators, administrators, using ethnographic perspectives and ethnographic tools for Education's purposes.

While this distinction is useful heuristically in framing the difference, in actual practice, the boundaries are often blurred (Geertz, 1983). Social scientists of education often collaborate with researchers and practitioners in education and employ the many kinds of knowledge generated within the disciplines of education; and those in education often employ frames, modes of inquiry and findings from the disciplines within the fields of anthropology and sociology. Thus, rarely is any ethnography or ethnographic study only of education or only in education. Nonetheless, the

distinction is useful in examining the intellectual sites within which ethnography and ethnographic studies on education have been located.

4.4.3 Philosophical Perspective of Ethnographic approach

In order to understand philosophical perspective of the ethnographic approach, three dominant perspectives in social sciences will be outlined. It is important to note that the philosophical perspective of the ethnographic approach cannot be separated from one of those three dominant perspectives. There are three dominant perspectives in the social sciences, namely the positivist perspective, the interpretive perspective and the critical perspective, which have different perception of reality. Positivists argue that reality is everything can be seen through the senses. It is 'out there', objective and governed by natural and fixed law (Shakouri, 2014). By contrast, interpretive theorists maintain that reality is 'not out there' and can be found in the minds of human beings. Reality is objective, constructed by social interaction and internally experienced by members of society (Sarantakos, 2013).

Furthermore, interpretive perspective "is concerned with the emphatic understanding of human action rather than with the forces that deemed to act on it" (Bryman, 2004). It means that the emphasis of interpretive perspective is not on the explanation of people behaviour, but rather on understanding of their behaviour.

"Identification and understanding" are the emphasis of the critical perspective (Dent, Khin, & Ismail, 2013). More specifically, this perspective has different view about reality. Critical theorists believe that reality is created by human beings, not by nature. There are powerful people who manipulate and persuade others to accept things and interpret them based on their own perspective.

Among those three dominant perspectives, the ethnographic approach adopts the second one that is interpretive perspective. It is mentioned earlier that the main objective of the ethnographic approach in social sciences is to comprehend the relationship between people and their social environment. However, understanding 'surface relationship' is not its emphasis. Instead, the ethnographic approach wants to go beyond this. It attempts to reveal reality, for instance what people's opinions are about a particular phenomenon occurred in their social context and what their action is. It is similar with the emphasis of interpretive perspective, which helps to understand human behavior and implements holism approach for in-depth studies. The former means that the ethnographic approach perceives people's action in the context of the whole system while the latter refers to the ethnographer's interest to rely on information obtained by involving in daily lives of the groups being investigated and experiencing culture the way these groups do.

4.4.4 Methodological Perspective of Ethnographic approach

Participant observation is considered as a central method of the ethnographic approach. It is often combined with other methods especially informal or unstructured interview. Participant observation means that ethnographer becomes part of the situation being studied in order to be able to feel the way people do in that situation. It is essential therefore, for the ethnographer to be actively involved in the respondents' daily lives. This method enables the ethnographer to depict what goes on, where and when a particular social phenomenon occurs, what and who are involved, how and why it happens (Gobo, 2011). In other words, participant observation can help the ethnographer to reveal reality behind the phenomenon happened in a social environment.

Study of documents, for instance a life history is different. According to Rahamah, Bakar, and Abdullah (2008), the life history is the autobiography of a person that can be gained via interview and guided conversation. This technique, therefore, enables the ethnographer to obtain insights into the respondents' world-view and social relationships.

It is no longer possible to view ethnography and ethnographic research as monolithic. So, ethnography and ethnographic research as situated inquiry, we identified a series of intellectual sites which have contextualized how ethnography and ethnographic research have been taken up by social scientists, educational researchers, teachers, students, and ordinary people. The sites we have identified are not intended to be comprehensive; rather, they are illustrative of how various intellectual sites influence the relationship between theory and method.

4.4.5. Designing an Ethnographic Research

An ethnographic research in general, involves a few prime notions that should be followed by the researcher that - people's behaviour should be studied in the context of their living of everyday life, rather than the setting created by the ethnographer(s); contextual data should be collected by using multiple data collection techniques with a major emphasis on observation as the principal one; the modes of data collection should be flexible and unstructured in nature to avoid the presupposed categories and to focus on what people exactly 'say' and 'do'; and the analysis of data involves attribution of the meanings of the human actions described and interpreted (Hammersley and Atkinson 1983, in Brewer, 2010).

Since ethnography inclines to unearth the shared meanings and practices of the social and cultural processes of the group under study, is a necessity to cultivate

an 'insight' to an ethnographic study. Considering the suggestions articulated by Kahn (2011) in this regard, an ethnographer has to go through five major steps-

- **Pre-Writing:** an indication on the researcher's concern of the culture that she/he will study along with her/his biases and presuppositions about the members of the group under study. In this phase, the researcher adds the research questions that she/he is trying to search and answer.
- **Introductions/consent forms:** the step requires the consent or permissions of the respondents. The ethnographer has to introduce and communicate about her/his research for asking consent from the respondents.
- **Field notes/ interview notes/ transcripts***:* this phase involves ethnographer's notes of the visits to the group or research site; notes taken during interviews with respondents; transcripts of interviews; descriptions of physical location, settings, and so on.
- **Journal:** it is a running internal monologue that clearly depicts ethnographer's thinking (what the ethnographer observes, what seemed to be significant, to what the researcher is confused about and what the ethnographer thinks is important to keep into the track) throughout the research.
- **Drafts and revisions of ethnographies:** the ethnographer's write up of the research includes multiple drafts and major overhauls in organization/structure, voice and contents, and all, that helps to understand the researcher's point of view to their readers.

Now, we are discussing the steps for conducting an ethnographic research as recommended by Henry (2009) in this regard-

- **Identifying the objectives:** the ethnographer should identify and determine the direction of the research to develop research question(s).
- **Context:** incorporating a social context in research not only provides more rounded descriptions of culture under study, but, is one of the major denominators of ethnography.
- **Fieldwork/ Participant Observation:** the phase includes the observation of people 'in situ' by participating and performing the daily routing of the setting to extend a deep attachment with the people and feel the essence of what is going on.

- **Immersion:** indicates subjecting the self- the body and personality to the set of situations of the respondents under study to penetrate the local understanding of their world.
- **Insider-Outsider:** during fieldwork, the ethnographers generally feel an insider-outsider transition. They cannot reach at the 'same' level to the members of that culture are habituated to stand. The way to reach closer to the insider's view depends on repetitive questioning of the local cultural categories and constructs.

Coming to an overall mode of ethnographic research, Hancok et al. (2009) argued that ethnography involves the following steps-

- **Research Question(s):** the research questions generally introduces an overall area of investigation and as the research proceeds, it is crucial to become more precise.
- **Selecting Suitable Approaches(s):** the clear idea for selecting a methodological approach entails what sorts of information or knowledge is important for the research.
- **Sampling:** in qualitative research, sampling may used in several stages-both while collecting data and when interpreting or reporting on it. Conducting an ethnographic research, the ethnographer generally selects the qualitative sampling methods, such as- theoretical sampling, convenience sampling, typical case sampling, critical case sampling, maximum variation sampling, intensity sampling and snowball sampling.
- **Choosing the Data Collection Techniques:** this phase includes the selection of data collection techniques for a deeper understanding of the concerned issues. In ethnography the major data collection techniques are- interviews (preferably the semi-structured, unstructured interviews and focus groups), observation (more specifically-participant observation), collection of documented materials(like-letters, diaries and photographs), and collection of narratives (the stories from the respondents).
- **Data Analysis:** analysis of data in an ethnographic research aims to summarize the mass of data collected and presenting the output that directs the most significant dimensions of the data. This phase involves-

➢ Keeping records and organizing the data

- Transcribing the qualitative data to produce the written versions ofinterviews and conversations
- Doing constant comparison that allows the researcher to generate themesof concern. The phase of constant comparison involves open coding(summary of the collected text within a few words on a line-by-line basis),progressive focusing (the large number of open codes are progressively focused to the wider categories of meaning), and summarizing and interpreting the findings (to find out the interrelation of the themes togetherthat indicates a pattern of the participants' thought of the concerned issue.

- **Presentation and Reporting:** The presentation of the research should be very clear and communicative to its audiences. The reporting involves a systematic arrangements of the findings with addressing properly the research questions, the ethnographer's outlook to the problems and issues of research, using direct quotations of the respondents as evidence, and using of separate chapters and/ or subheadings of the major themes, generated from the data.

The ethnography and ethnographic research can be treated as a set of social and cultural practices employed by members of various 'communities': disciplinary-based communities, educational research communities, and classroom communities. As such, ethnographic practices - like any set of social and cultural practices - are ways that people in a site act and react to each other in pursuit of an agenda; including research agendas, educational agendas, and social, cultural and institutional change agendas.. Like any set of social and cultural practices, although based on past practices that provide people with 'folk' models of what the practices 'look like,' how they are to be enacted, and what meaning and significance they have, no set of practices, including ethnographic practices, are fully predetermined. As such,ethnography and ethnographic research continues to evolve and change as a consequence ofthe new sites (intellectual, topical, institutional, educational, physical, geographical, social, andcultural sites) in which it is situated, and as a consequence of the people who take it up and theagendas they pursue.

4.4.6 Philosophical Perspective of Case study approach

Some theorists believe that case study approach is a meth-od in logical positivist tradition (Yin, 2003). This belief is based on the reason that this approach "can be conducted through the collection and analysis of empirical data" (Yin, 2003, p. 163). These data then are used to present findings and conclusions. However, if we

trace back on the types of case study: whether single or multiple, case study can be exploratory, explanatory or descriptive, it will be clear that this approach also adopts interpretive perspective. Basically, these three types of case study focus on the social phenom-enon. Case study tries to find out what kind of phenomenon exists, then explain how it occurred by describing it com-pletely. In the attempt to explore, explain and describe this phenomenon, the researcher needs to understand about point of view of people who experienced it since reality only can be found in their minds, which is similar with the perception of interpretive perspective.

Moreover, case study also stresses the holistic examina-tion of the phenomenon or the issue (Harrison, Birks, Frank-lin, & Milles, 2017). In other words, holism approach is ap-plied. It means that it tries to analyse a particular case and bring it into wider category of cases. The researcher then relates it to other cases that have similar characteristics.

4.4.7 Methodological Perspective of Case study approach

The common methods used in the case study approach are life histories, document, in-depth interviews and partic-ipant observation. It can be seen that case study uses the same methods of data collection with the ethnographic ap-proach but in-depth interviews. This method therefore, will be outlined below. There are many types of interviews. Two examples of these types are structured and unstructured in-terviews. Structured interview refers to the interview, which has a strict procedure and schedule. Content, wording, order of the questions and other elements of the interview are un-changeable. Unstructured interview is a type of interview, which has no strict schedule to follow and its structure is flexible (Buriro, Awan, & Lanjwani, 2017). The in depth-in-terview commonly used in the case study approach is one form of unstructured interview. The in-depth interview pro-vides more freedom for the interviewer to present the ques-tions, in order to meet the goals of the study.

4.4.8 Designing a Case study approach

According to Yin, case studies can be used to explain, describe or explore events or phenomena in the everyday contexts in which they occur Case studies may be approached in different ways depending on the epistemological standpoint of there searcher, that is, whether they take a critical (questioning one's own and others' assumptions), interpretivist(trying to understand individual and shared social meanings) or positivist approach (orientating to wardsthe criteria of natural sciences, such as

focusing on generalisability considerations) . Whilst such a schema can be conceptually helpful, it may be appropriate to draw on more than one approach in any case study, particularly in the context of conducting health services research. Doolin has, for example, noted that in the context of undertaking interpretative case studies, researchers can usefully draw on a critical, reflective perspective which seeks to take into account the wider social and political environment that has shaped the case.

The main stages of research activity when planning and undertaking a case study; the crucial stages are: defining the case; selecting the case(s); collecting and analyzing the data; interpreting data; and reporting the findings.

- **Defining the case:** Carefully formulated research question(s), informed by the existing literature and a prior appreciation of the theoretical issues and setting(s), are all important in appropriately and succinctly defining the case. Crucially, each case should have a pre-defined boundary which clarifies the nature and time period covered by the case study (i.e. its scope, beginning and end), the relevant social group, organization or geographical area of interest to the investigator, the types of evidence to be collected, and the priorities for data collection and analysis. A theory driven approach to defining the case may help generate knowledge that is potentially transferable to a range of clinical contexts and behaviours; using theory is also likely to result in a more informed appreciation of, for example, how and why interventions have succeeded or failed.
- **Selecting the case(s):** The decision on how to select the case(s) to study is a very important one that merits some reflection. In an intrinsic case study, the case is selected on its own merits. The case is selected not because it is representative of other cases, but because of its uniqueness, which is of genuine interest to the researchers. For an instrumental case study, selecting a "typical" case can work well. In contrast to the intrinsic case study, the particular case which is chosen is of less importance than selecting a case that allows the researcher to investigate an issue or phenomenon.
- **Collecting the data:** In order to develop a thorough understanding of the case, the case study approach usually involves the collection of multiple sources of evidence, using a range of quantitative (e.g. questionnaires, audits and analysis of routinely collected healthcare data) and more commonly

qualitative techniques (e.g. interviews, focus groups and observations). The use of multiple sources of data (data triangulation) has been advocated as a way of increasing the internal validity of a study (i.e. the extent to which the method is appropriate to answer the research question). An underlying assumption is that data collected in different ways should lead to similar conclusions, and approaching the same issue from different angles can help develop a holistic picture of the phenomenon.

- **Analyzing, interpreting and reporting case studies:** Making sense and offering a coherent interpretation of the typically disparate sources of data (whether qualitative alone or together with quantitative) is far from straightforward. Repeated reviewing and sorting of the voluminous and detail-rich data are integral to the process of analysis. In collective case studies, it is helpful to analyze data relating to the individual component cases first, before making comparisons across cases. Attention needs to be paid to variations within each case and, where relevant, the relationship between different causes, effects and outcomes. Data will need to be organized and coded to allow the key issues, both derived from the literature and emerging from the dataset, to be easily retrieved at a later stage. An initial coding frame can help capture these issues and can be applied systematically to the whole dataset with the aid of a qualitative data analysis software package. The Framework approach is a practical approach, comprising of five stages (familiarization; identifying a thematic framework; indexing; charting; mapping and interpretation), to managing and analyzing large datasets.

The case study approach is, as with all research, not without its limitations. Case study research has sometimes been criticized for lacking scientific rigour and providing little basis for generalization (i.e. producing findings that may be transferable to other settings). There are several ways to address these concerns, including: the use of theoretical sampling (i.e. drawing on a particular conceptual framework); respondent validation (i.e. participants checking emerging findings and the researcher's interpretation, and providing an opinion as to whether they feel these are accurate); and transparency throughout the research process. Transparency can be achieved by describing in detail the steps involved in case selection, data collection, the reasons for the particular methods chosen, and the researcher's background and level of involvement (i.e. being explicit about how the researcher has influenced data collection and interpretation). Seeking potential, alternative explanations, and

being explicit about how interpretations and conclusions were reached, help readers to judge the trustworthiness of the case study report.

4.5 Narrative/discourse and visual methodologies

4.5.1 Introduction

Narrative has been one of the major themes in humanistic and social scientific thought since the mid-twentieth century. The essence of humanness, long characterized as the tendency to make sense of the world through rationality, has come increasingly to be described as the tendency to tell stories, to make sense of the world through narrative. In linguistics, narrative was one of the first discourse genres to be analyzed, and it has continued to be among the most intensively studied of the things people do with talk.

Narrative inquiry is an umbrella term that captures personal and human dimensions of experience over time, and takes account of the relationship between individual experience and cultural context (Clandinin and Connelly 2000). Narrative inquiry is a means by which we systematically gather, analyse, and represent people's stories as told by them, which challenges traditional and modernist views of truth, reality, knowledge and personhood.

Narrative research is a term that subsumes a group of approaches that in turn rely on the written or spoken words or visual representation of individuals. These approaches typically focus on the lives of individuals as told through their own stories. The emphasis in such approaches is on the story, typically both what and how is narrated.

Narrative research can be considered both a research method in itself but also the phenomenon under study.

Narrative methods can be considered "real world measures" that are appropriate when "real life problems" are investigated. In a basic linear approach, they encompass the study of the experiences of single individual embracing stories of the life and exploring the learned significance of those individual experiences. However, in most cases one will be creating an aggregate of narratives each bearing on the others.

Narrative research is set out by the validation of the audience. It is a useful part of the social science investigation, but may not always stand alone for evidence and support for the conclusions of a report. Whether or not it is a part of a great presentation, whether it is a standalone piece of research, it has to be accepted on its own merits as individual experience and the interpretation of thereof. The question arises as to the accuracy of the story looked at objectively even though it must be viewed in its socio-cultural context. The narrative gives one's individual view to be accessed on its merits. Such validation is possible by corroboration from another narrative.

While some types of qualitative analysis have a standard set of procedures, narrative research is questionable in this regard. One of the weaknesses of studying narratives is that the text is by its own nature linguistically subjective i.e. difficult to quantitatively access in an objective manner since it is subjective i.e. personally meaningful. A number of data collection methods can be used, as the researcher and the research subjects work together in this collaborative dialogic relationship. Data can be in the form of field notes; journal records; interview transcripts; one's own and other's observations; storytelling; letter writing; autobiographical writing; documents such as school and class plans, newsletters, and other texts, such as rules and principles; and pictures. To this list, one should add audio and video recordings, as these are also useful data in narrative research.

4.5.2 Designing Narrative/discourse Research

Any narrative/discourse, by definition, includes at least two "narrative clauses." A narrative clause is one that cannot be moved without changing the order in which events must be taken to have occurred. If two narrative clauses are reversed, they represent a different chronology: "I punched this boy / and he punched me" implies a different sequence of events than "This boy punched me / and I punched him." For Labov, "narrative" is not any talk about the past, or any talk about events; it is specifically talk in which a sequence of clauses is matched to a sequence of "events which (it is inferred) actually occurred" (Labov 1972). Although "minimal narratives" like the two about punching in the previous paragraph consist of just two narrative clauses, most personal experience narrative (PEN) is more complex, including more narrative clauses as well as "free" clauses that serve other functions. A "fully developed" narrative may include clauses or sets of clauses with the following functions, often roughly in this order:

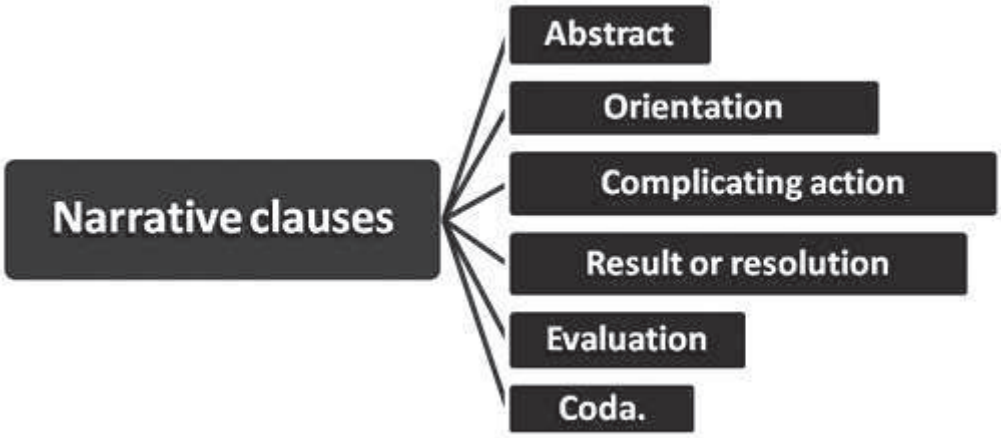

Figure 4.2: Schematic of narrative clauses

Each of these elements of PEN serves a double purpose, making reference to events, characters, feelings, and so on that are understood to have happened or existed outside of the ongoing interaction, and at the same time structuring the interaction in which the story is being told by guiding the teller and the audience through the related events and insuring that they are comprehensible and worth recounting.

1) Abstract: The abstract consists of a clause or two at the beginning of a narrative summarizing the story to come. In response to Labov's "danger of death" question, for example, a person might begin, "I talked a man out of – Old Doc Simon I talked him out of pulling the trigger," then going on to elaborate with a narrative. (Examples are Labov's.) The abstract announces that the narrator has a story to tell and makes a claim to the right to tell it, a claim supported by the suggestion that it will be a good story, worth the audience's time and the speaking rights the audience will temporarily relinquish.

2) Orientation: Orientation in a narrative introduces characters, temporal and physical setting, and situation: "It was on a Sunday, and we didn't have nothing' to do after I – after we came from church"; "I had a dog – he was a wonderful retriever, but as I say he could do everything but talk." Orientation often occurs near the beginning, but may be interjected at other points, when needed. The characteristic orientation tense in English is the past progressive: "I was sitting' on the corner an' shit, smoking' my cigarette, you know;" "We were doing the 50-yard dash."

3) Complicating action: Complicating action clauses are narrative clauses that recapitulate a sequence of events leading up to their climax, the point of maximum suspense. These clauses refer to events in the world of the story and, in the world of the telling, they create tension that keeps auditors listening.

4) Result or resolution: The result or resolution releases the tension and tells what finally happened. Often just before the result or resolution, but also throughout the narrative, are elements that serve as evaluation, stating or underscoring what is interesting or unusual about the story, why the audience should keep listening and allow the teller to keep talking.

5) Evaluation: Evaluation may occur in free clauses that comment on the story from outside: "And it was the strangest feeling"; "But it was really quite terrific"; or in clauses that attribute evaluative commentary to characters in the story: "I just closed my eyes / I said, 'O my God, here it is!'" Or evaluation can be embedded in the narrative, in the form of extra detail about characters ("I was shaking' like a leaf"), suspension of the action via paraphrase or repetition; "intensifiers" such as gesture or quantifiers ("I knocked him all out in the street"); elements that compare what did happen with what did not or could have happened or might happen; "correlatives" that tell what was occurring simultaneously; and "explicative" that are appended to narrative or evaluative clauses. (Labov 1972: 354–96.)

6) Coda: At the end of the story, the teller may announce via a coda that the story is over ("And that was that"), sometimes providing a short summary of it or connecting the world of the story with the present ("That was one of the most important;" "He's a detective in Union City / And I see him every now and again")

Even very young children appear to want to talk about the past (Miller and Sperry 1988). As they learn to take other people's perspectives, children gradually learn to provide orientational and evaluative detail that can keep audiences informed and involved. Kernan (1977) shows how evaluative devices develop with age, younger children implying their feelings and rarely recreating speech while older children rely more on explicit strategies such as telling how they felt and constructing dialog for themselves and other story characters. Romaine (1984: 146–58) uses Labov's characterization of story structure to analyze narratives by Scottish pre-adolescents, suggesting that while evaluative strategies vary, the syntax tends to be simple and relatively iconic, avoiding such strategies as passivization and subordination. McCabe and Peterson (1991) studied pre-adolescents' uses of connectives such as then, and, and because in elicited stories. Hudson and Shapiro

(1991) examine how developing expertise in remembering and representing events, constructing narrative macrostructures, using tense, aspect, pronouns, and anaphora, and interpreting the context all come together as children mature. Other studies of the development of storytelling ability are Botvin and Sutton-Smith (1977), Umiker-Sebeok (1979), Bennett-Kastor (1983, 1986), Preece (1987), Cook-Gumperz and Green (1984), Berman (1988), and many of the chapters in McCabe and Peterson (1991).

As they acquire cognitive and linguistic abilities, children are also socialized into the functions of narrative in their communities. Among the best-known studies of this process is Heath's (1982, 1983) work with families in two working-class communities in the southern United States. Working-class white children in "Roadville" were taught to tell "factual" stories that ended with morals about what they had learned; workingclass African American children in "Trackton" were encouraged to entertain others with fantastic tales. This and other differences in pre-school socialization have implications for children's success in school, where, for example, white children may already know to tell "sharing time" stories the way teachers expect but African American children may not (Michaels and Collins 1984). Among other work on narrative socialization are McCabe and Peterson (1991).

4.5.3 Designing visual methodological Research

Visual Methodologies is an indispensable resource for anyone working with visual materials. It offers practical guidance and expert theoretical orientation on how to approach, think about, and interpret visual culture, ranging from archival photography and documentary film to websites and social media.

Visual methodologies are used to understand and interpret images (Barbour, 2014) and include photography, film, video, painting, drawing, collage, sculpture, artwork, graffiti, advertising, and cartoons. Visual methodologies are a new and novelapproach to qualitative research derived from traditional ethnography methods used in anthropology and sociology. Therehas been recent enthusiasm for the use of visual methods inqualitative research (Barbour, 2014). They add value to already existing methods by bringing another dimension (Balmer, Griffiths, & Dunn, 2015), by capturing rich multidimensional data (Mah, 2015), and by adding valuable insights into the everyday worlds of participants (Barbour, 2014). Researchers use these images and methods to create knowledge (Thomas,

2009), which is becoming increasingly recognized as advantageous in health and illness research (Balmer et al., 2015). Visual methodologies are used to understand

and interpret images (Barbour, 2014) and include photography, film, video, painting, drawing, collage, sculpture, artwork, graffiti, advertising, and cartoons. Visual methodologies are a new and novel approach to qualitative research derived from traditional ethnography methods used in anthropology and sociology. There has been recent enthusiasm for the use of visual methods in qualitative research (Barbour, 2014). They add value to already existing methods by bringing another dimension (Balmer, Griffiths, & Dunn, 2015), by capturing rich multidimensional data (Mah, 2015), and by adding valuable insights into the everyday worlds of participants (Barbour, 2014). Researchers use these images and methods to create knowledge (Thomas, 2009), which is becoming increasingly recognized as advantageous in health and illness research (Balmer et al., 2015).Interpretations of visual images broadly concur that there are three sites at which the meanings of an image are made:

a) The site(s) of the production of production an image,

b) The site of the image itself, and

c) The site(s) where it is seen by vari-ous audiences

Each of these sites has three differ-ent aspects. These different aspects are modalities, and there are three of these that can contribute to a critical understanding of images:

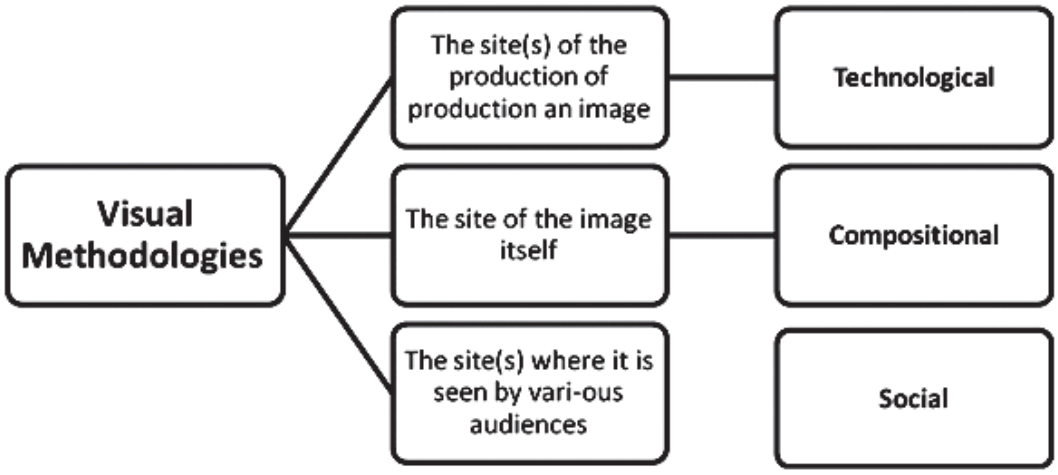

Figure 4.3: Design of visual methodological Research

• **Technological:** Mirzoeff (1998) defines a visual technology as 'any form of apparatus designed either to be looked at or to enhance natural vision, from oil paintings to television and the Internet'.

• **Compositional:** Compositionality refers to the specific material qualities of an image or visual object. When an image is made, it draws on a number of formal strategies: content, colour and spatial organization, for example. Often, particular forms of these strategies tend to occur together, so that, for example, Berger (1972) can define the Western art tradition painting of the nude in terms of its specific compositional qualities. Chapter 3 will elaborate the notion of composition in relation to paintings.

• **Social:** This is very much a shorthand term. What I mean it to refer to are the range of economic, social and political relations, institutions and practices that surround an image and through which it is seen and used.

Many of the theoretical disagreements about visual culture, visualities and visual objects can be understood as disputes over which of these sites and modalities are most important, how and why. Visual imagery is never innocent; it is always constructed through various practices, technologies and knowledge. A critical approach to visual images is therefore needed: one that thinks about the agency of the image, considers the social practices and effects of its viewing, and reflects on the specificity of that viewing by various audiences including the academic critic. The meanings of an image or set of images are made at three sites - the sites of production, the image itself and its audiencing- and there are three modalities to each of these sites: technological, compositional and social. Theoretical debates about how to interpret images can be understood as debates over which of these sites and modalities is most important for understanding an image, and why. These debates affect the methodology that is most appropriately brought to bear on particular images; all of the methods discussed in this book are better at focusing on some sites and modalities than others.

4.6 Mixed method

4.6.1 Introduction

Mixed methods research (MMR) has become increasingly popular over the last 25 years. The term “mixed methods” refers to an emergent methodology of research that advances the systematic integration, or “mixing,” of quantitative and qualitative data within a single investigation or sustained program of inquiry. A mixed method combines both qualitative and quantitative elements to produce a better research quality by eliminating the biases inherent to either quantitative or qualitative methods alone. However, collectingqualitative and quantitative data was commonplace in

many social sciences throughout the first 60 years of the 20th Century. After gaining traction through this formative period and the ensuing era of paradigm debate, MMR expanded into a distinct methodology equipped with procedures and nomenclature (Creswell & Plano Clark, 2011). There is now little question of the legitimacy and utility of MMR in various sectors of inquiry. Thus a mixed research method usually results in profounder research due to its "methodological pluralism or eclecticism" (Johnson &Onwuegbuzie, 2004). The main assumption is that when an inquirer combines both quantitative and qualitative methods, it provides a better understanding of the problem than using either method alone. Mixed methods research, therefore, can be very useful in getting a deep understanding of any research. However, given that mixed research method requires more time and effort than either of qualitative or quantitative methods, it is imperative that this method be used only for that research in which a profound understanding of the phenomenon is of great importance to the researcher. In a business setting, mixed research would be more costly and should be used only when the research result would be very useful to the organization.

4.6.2 Designing Mixed Methods Research

Mixed methods research originated in the social sciences and has recently expanded into the health and medical sciences including fields such as nursing, family medicine, social work, mental health, pharmacy, allied health, and others. In the last decade, its procedures have been developed and refined to suit a wide variety of research questions (Creswell and Plano Clark, 2011). These procedures include advancing rigor, offering alternative mixed methods designs, specifying a shorthand notation system for describing the designs to increase communication across fields, visualizing procedures through diagrams, noting research questions that can particularly benefit from integration, and developing rationales for conducting various forms of mixed methods studies.

The core characteristics of a well-designed mixed methods research include the following:

1. Collecting and analyzing both quantitative (closed-ended) and qualitative (open-ended) data.
2. Using rigorous procedures in collecting and analyzing data appropriate to each method's tradition, such as ensuring the appropriate sample size for quantitative and qualitative analysis.

3. Integrating the data during data collection, analysis, or discussion.
4. Using procedures that implement qualitative and quantitative components either concurrently or sequentially, with the same sample or with different samples.
5. Framing the procedures within philosophical/theoretical models of research, such as within a social constructionist model that seeks to understand multiple perspectives on a single issue.

Mixed methods can be an ideal technique to assess complex interventions such as:

a. Validate findings using quantitative and qualitative data sources.
b. Use qualitative data to explore quantitative findings.
c. Develop survey instruments.
d. Use qualitative data to augment a quantitative outcomes study.
e. Involve community-based stakeholders.

4.6.3 Advantages and Limitations of Mixed Methods

Advantages: Using a mixed methods study has several advantages, which we discuss below.

- **Compares quantitative and qualitative data.** Mixed methods are especially useful in understanding contradictions between quantitative results and qualitative findings.
- **Reflects participants' point of view.** Mixed methods give a voice to study participants and ensure that study findings are grounded in participants' experiences.
- **Fosters scholarly interaction.** Such studies add breadth to multidisciplinary team research by encouraging the interaction of quantitative, qualitative, and mixed methods scholars.
- **Provides methodological flexibility.** Mixed methods have great flexibility and are adaptable to many study designs, such as observational studies and randomized trials, to elucidate more information than can be obtained in only quantitative research.
- **Collects rich, comprehensive data.** Mixed methods also mirror the way individuals naturally collect information—by integrating quantitative and qualitative data. For example, sports stories frequently integrate quantitative

data (scores or number of errors) with qualitative data (descriptions and images of highlights) to provide a more complete story than either method would alone.

Limitations: Mixed methods studies are challenging to implement, especially when they are used to evaluate complex interventions. Below we discuss several challenges.

- **Increases the complexity of evaluations.** Mixed methods studies are complex to plan and conduct. They require careful planning to describe all aspects of research, including the study sample for qualitative and quantitative portions (identical, embedded, or parallel); timing (the sequence of qualitative and quantitative portions); and the plan for integrating data. Integrating qualitative and quantitative data during analysis is often a challenging phase for many researchers.
- **Relies on a multidisciplinary team of researchers.** Conducting high-quality mixed methods studies requires a multidisciplinary team of researchers who, in the service of the larger study, must be open to methods that may not be their area of expertise. Finding qualitative experts who are also comfortable discussing quantitative analyses and vice versa can be challenging in many environments. Given that each method must adhere to its own standards for rigor, ensuring appropriate quality of each component of a mixed methods study can be difficult (Wisdom, Cavaleri, Onwuegbuzie, et al., 2011). For example, quantitative analyses require much larger sample sizes to obtain statistical significance than do qualitative analyses, which require meeting goals of saturation (not uncovering new information from conducting more interviews) and relevance. Embedded samples, in which a qualitative subsample is embedded within a larger quantitative sample, can be useful in cases of inadequate statistical power.
- **Requires increased resources.** Finally, mixed methods studies are labor intensive and require greater resources and time than those needed to conduct a single method study.

The integration of quantitative and qualitative data in the form of a mixed methods study has great potential to strengthen the rigor and enrich the analysis and findings of any evaluation. By carefully selecting the mixed method design that best suits the evaluation's questions and meets its resource constraints, evaluators can facilitate deeper and more meaningful learning.

4.7 Themes, coding and presentation

4.7.1 Themes

"Theme" is the main product of data analysis that yields practical results in the field of study. Theme is used as attribute, descriptor, element, and concept. As an implicit topic that organizes a group of repeating ideas, it enables researchers to answer the study question. It contains codes that have a common point of reference and has a high degree of generality that unifies ideas regarding the subject of inquiry. It is considered a thread of underlying meaning implicitly discovered at the interpretative level and elements of subjective understandings of participants. Each theme may have some subthemes as subdivisions to obtain a comprehensive view of data and uncovers a pattern in the participants' account.

A broad interest has been shown in recent years in the process of data analysis, but a detailed description of how researchers identify theme is under-reported. A probable reason is that in addition to empiricism, the way to find theme involves intuition that is difficult to be described. Although some suggested techniques are shown to be effective under some conditions, their nature and the way in which they are generated varies between different qualitative approaches. More importantly there is little practical explanation about how theme is developed. Mojtaba Vaismoradi, et.al. proposed four phases of theme development: "initialization", "construction", "rectification", and "finalization". Each phase consists of some stages that are described asfollow (Table)

Table 4.1: Phases and stages of theme development in qualitative content and thematic analysis

Phases	Stages
Initialization	Reading transcriptions and highlighting meaning units;Coding and looking for abstractions in participants' accounts;Writing reflective notes.
Construction	Classifying; Comparing; Labeling; Translating & transliterating;Defining & describing.
Rectification	Immersion and distancing;Relating themes to established knowledge;Stabilizing.
Finalization	Developing the story line

4.7.2 Coding

A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data. The data can consist of interview transcripts, participant observation field notes, journals, documents, literature, artifacts, photographs, video, websites, e-mail correspondence, and so on. The portion of data to be coded during First Cycle coding processes can range in magnitude from a single word to a full sentence to an entire page of text to a stream of moving images. In Second Cycle coding processes, the portions coded can be the exact same units, longer passages of text, and even a reconfiguration of the codes themselves developed thus far. Just as a title represents and captures a book or film or poem's primary content and essence, so does a code represent and capture a datum's primary content and essence. The three primary purposes of The Coding Manual for Qualitative Researchers are:

- To briefly discuss the functions of codes, coding, and analytic memo writing during the qualitative data collection and analytic processes
- To profile a selected yet diverse repertoire of coding methods generally applied in qualitative data analysis, and
- To provide readers sources, descriptions, examples, recommended applications, and exercises for coding and further analyzing qualitative data.

Coding as the process of data reduction is an element of data organization in most qualitative approaches. To facilitate coding, different types of codes are recognized in qualitative content analysis and thematic analysis: "Conceptual code" identifies key elements, domains and dimensions of the study phenomenon; "relationship code" identifies links between elements, domains and dimensions; "participant perspective code" identifies the participant's positive, negative, or indifference comments about a particular experience; "participant characteristic code" and "setting code" show the general characteristics of participants and the place in which the phenomenon has happened, respectively. Such a classification not only helps researchers organize codes, but also enables detailed comparison and classification prior to the subsequent analytical steps.

Coding reduces the amount of raw data to that which is relevant to the research question, breaks the data down to manageable sections, and takes researchers through the transformation of raw data to higher-level insights or abstractions as

the development of theme. Researchers recognize coding as one level of abstraction, because they use intuition to extract the meaning of data and present description and interpretation at a higher logical level. Thus to increase the rigour of qualitative content analysis and thematic analysis, ambiguities surrounding coding should be reduced through illustrating progression from concrete to abstraction. During the abstraction process, according to researchers' judgment, the transformation process from concrete to abstract is conducted in such a way that each step has a higher level of "generality". At a practical level, concurrently with the initial data collection, after reaching a general understanding of the content and context of the phenomenon under study, the coding process is started to reveal explicit and implicit meanings. Finding the appropriate answer to the research question depends on selecting the relevant section of the transcription for coding and choosing an appropriately sized section so as to prevent losing subtleties in the meaning. Next, researchers address important codes for further consideration, although withholding any final decision until the latter steps of data analysis. Beginning coding with a specific focus or narrower definition hinders discerning codes or obscures the ability to recognize themes.

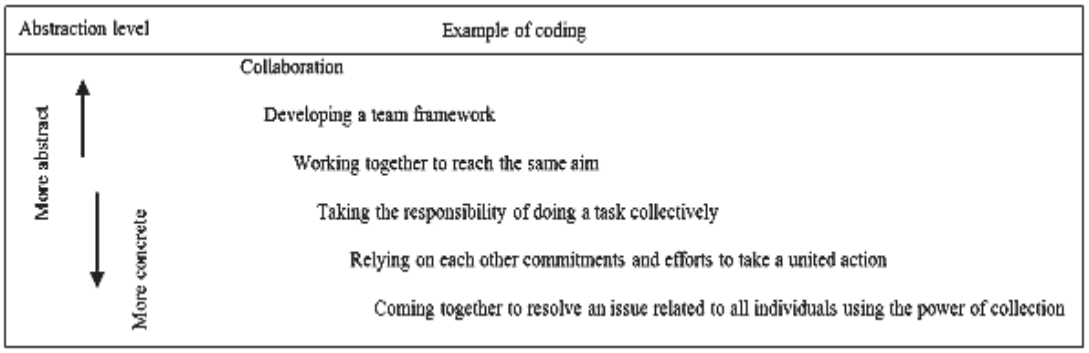

Figure 4.4: An example of abstraction for coding in qualitative content

4.7.3 Presentation

Presentation refers to the organization of data into tables, graphs or charts, so that logical and statistical conclusions can be derived from the collected measurements. Data may be present in three Methods:

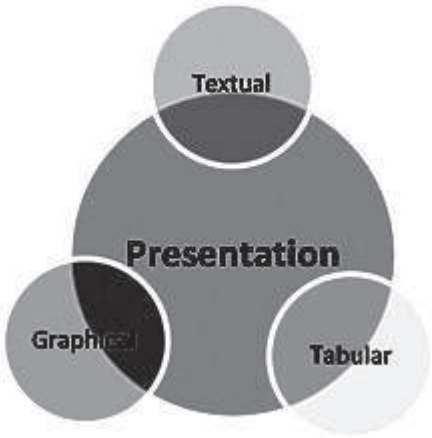

Figure 4.5: Methods of Presentation

The presentation of qualitative research findings in its institutional, disciplinary, and rhetorical context can be expressed as being a particular kind of genre, an aspect of qualitative method, and a contribution to a bigger scholarly conversation. The qualitative research findings presentation is a distinctive form of engagement, a genre in and of itself, at or close to the end stage of knowledge production. The presentation never just "is" but incorporates a multitude of choices and assumptions in its framing, emphasis, content, and delivery. The presentation expresses all manner of interpretations, values, and ideologies of its presenters around whatis included and what is excluded, what is emphasized and what is downplayed, dismissed, or otherwise ignored. The presentation is also always enacted within a social context and subject to various unstated norms. Resonant presentations usually involve clear exposition and appropriate audience relationships, with particular techniques being employed to build rapport, persuade, or otherwise communicate.

Qualitative research presentations are not merely a "genre" form of communication but also an integral part of qualitative research method. Qualitative methods, in turn, are increasingly diverse in form and theory—around epistemology, rigor, methods, data collection techniques, sampling, and analysis. Nevertheless, and despite these differences, the act of presenting qualitative research findings is never merely about communication, dissemination, and engagement but serves to reflect the purpose(s) of qualitative studies, and ultimately, methodological rigor. Different qualitative research methods or movements seek to generate particular

effects, including eliciting emotions (Denzin, 1984), creating verisimilitude (Schwandt, 2007), answering questions about reality (Hammersley, 2008), representing elements such as a "good story" (Clandinin& Caine,2008), how people view and experience the world (Hammersley, 2008) or particular needs or problems (Morse, 2012). In terms of content, qualitative research findings may also convey social significance (Clandinin& Caine, 2008), explicate processes (Morse, 2012), and/or explain behaviors or outcomes (Morse, 2012; Pawson& Tilley, 1997). Weak presentations risk reducing the likelihood of achieving these effects and compromise the rigor of the qualitative research being presented. Thus, depending on the approach, authors presenting qualitative studies use their findings to perform a variety of functions linked to representing the interplay between the text itself and the perception and understanding of those being presented to.

Qualitative data may be of the following type for presentation:

a. Subjective: A subjective point of view is something based on one's opinions, perspectives, beliefs, discoveries, desires, and feelings. It focuses on the writer's personal point of view and not built on facts that others see or things others go through. Third person point of view can also be subjective.

b. Interpretative: Interpretive presentation is appropriate for the audience, and provides a clear focus for their connection with the resource(s) by demonstrating the cohesive development of a relevant idea or ideas, rather than relying primarily on a recital of a chronological narrative or a series of related facts.

c. Descriptive: A descriptive presentation can refer to an assignment in which you communicate a message in a well-planned, well-designed, well-presented manner. It must demonstrate neatness, visibility, clarity of design, creativity, obvious preparation, and more.

d. Holistic: A *holistic* approach means thinking about the big picture. In a medical setting, *holistic* refers to addressing the whole person, including their physical, mental, and emotional health, while taking social factors into consideration.

e. Copious: abundant, superabundant, plentiful expression.

Forms of qualitative data include:

- Audio recordings and transcripts from in-depth or semi-structured interviews
- Structured interview questionnaires containing substantial open comments including a substantial number of responses to open comment items.

- Audio recordings and transcripts from focus group sessions.
- Field notes (notes taken by the researcher while in the field (setting) being studied)
- Video recordings (e.g., lecture delivery, class assignments, laboratory performance)
- Case study notes
- Images
- Documents (reports, meeting minutes, e-mails)
- Diaries, video diaries
- Observation notes
- Press clippings
- Photographs.

Qualitative research is becoming increasingly presented, accepted and published in different reputed journals. Some journals and publishers have guidelines for presenting qualitative research, for example, the British Medical Journal and Bio-medcentral.Medical Education published a useful series of articles on qualitative research. Some of the important issues that should be considered by authors, reviewers and editors when publishing qualitative research are discussed below:

- **Introduction:** A good introduction provides a brief overview of the manuscript, including the research question and a statement justifying the research question and the reasons for using qualitative research methods. This section also should provide background information, including relevant literature from pharmacy, medicine, and other health professions, as well as literature from the field of education that addresses similar issues. Any specific educational or research terminology used in the manuscript should be defined in the introduction.
- **Methods:** The methods section should clearly state and justify why the particular method, for example, face to face semi-structured interviews, was chosen. The method should be outlined and illustrated with examples such as the interview questions, focusing exercises, observation criteria, etc. The criteria for selecting the study participants should then be explained and justified. The way in which the participants were recruited and by whom also must be stated. A brief explanation/description should be included

of those who were invited to participate but chose not to. It is important to consider ''fair dealing,'' i.e., whether the research design explicitly incorporates a wide range of different perspectives so that the viewpoint of 1 group is never presented as if it represents the sole truth about any situation. The process by which ethical and or research/institutional governance approval was obtained should be described and cited.

- **Sampling:** The study sample and the research setting should be described. Sampling differs between qualitative and quantitative studies. In quantitative survey studies, it is important to select probability samples so that statistics can be used to provide generalizations to the population from which the sample was drawn. Qualitative research necessitates having a small sample because of the detailed and intensive work required for the study. So sample sizes are not calculated using mathematical rules and probability statistics are not applied. Instead qualitative researchers should describe their sample in terms of characteristics and relevance to the wider population. Purposive sampling is common in qualitative research. Particular individuals are chosen with characteristics relevant to the study who are thought will be most informative. Purposive sampling also may be used to produce maximum variation within a sample. Participants being chosen based for example, on year of study, gender, place of work, etc. Representative samples also may be used, for example, 20 students from each of 6 schools of pharmacy. Convenience samples involve the researcher choosing those who are either most accessible or most willing to take part. This may be fine for exploratory studies; however, this form of sampling may be biased and unrepresentative of the population in question. Theoretical sampling uses insights gained from previous research to inform sample selection for a new study. The method for gaining informed consent from the participants should be described, as well as how anonymity and confidentiality of subjects were guaranteed. The method of recording, e.g., audio or video recording, should be noted, along with procedures used for transcribing the data.
- **Data Analysis:** A description of how the data were analyzed also should be included. Was computer-aided qualitative data analysis software such as NVivo (QSR International, Cambridge, MA) used? Arrival at ''data saturation'' or the end of data collection should then be described and justified. A good rule when considering how much information to include is that readers should have been given enough information to be able to carry out similar

research themselves. One of the strengths of qualitative research is the recognition that data must always be understood in relation to the context of their production.

- **Discussion:** The findings should be presented in the context of any similar previous research and or theories. A discussion of the existing literature and how this present research contributes to the area should be included. A consideration must also be made about how transferrable the research would be to other settings. Any particular strengths and limitations of the research also should be discussed. It is common practice to include some discussion within the results section of qualitative research and follow with a concluding discussion. The researcher should critically examine their own influence on the design and development of the research, as well as on data collection and interpretation of the data, e.g., were they an experienced teacher who researched teaching methods? If so, they should discuss how this might have influenced their interpretation of the results.
- **Conclusion:** The conclusion should summarize the main findings from the study and emphasize what the study adds to knowledge in the area being studied. May sand Pope suggest the researcher ask the following 3 questions to determine whether the conclusions of a qualitative study are valid: How well does this analysis explain why people behave in the way they do? How comprehensible would this explanation be to a thoughtful participant in the setting? How well does the explanation cohere with what we already know?

Text, tables, and graphs are effective communication media that present and convey data and information. They aid readers in understanding the content of research, sustain their interest, and effectively present large quantities of complex information. For this reason, researchers must pay as close attention to selecting appropriate methods of data presentation as when they were collecting data of good quality and analysing them. In addition, having a well-established understanding of different methods of data presentation and their appropriate use will enable one to develop the ability to recognize and interpret inappropriately presented data or data presented in such a way that it deceives readers' eyes.

4.8 Let us sum up

The Grounded Theory

- Qualitative research is a process of exploring the potential antecedents and factors about which little has been known and explored

- Qualitative research comprises of the following methods: logic, ethnography, discourse analysis, case study, open-ended interview, participant observation, counseling, therapy, grounded theory, biography, comparative method, introspection, casuistry, focus group, literary criticism, meditation practice, historical research, etc.
- The 'grounded theory' can be defined as 'The theory that was derived from data, systematically gathered and analyzed through the research process'
- The 'grounded theory' has been developed by two sociologists, Barney Glaser & Anselm Strauss.
- The 'grounded theory' studies can commence with a variety of sampling techniques, many commence with purposive sampling, followed by concurrent data generation and/or collection and data analysis, through various stages of coding, undertaken in conjunction with constant comparative analysis, theoretical sampling and memoing.

Ethnography and case study

- Ethnography is "the description and interpretation of a culture or social group"
- An ethnographic research in general, involves Pre-Writing, Introductions/ consent forms, Field notes/ interview notes/ transcripts, journals, Drafts and revisions of ethnographies.
- Case study is an approach, which involves studying indi-vidual cases in their real life context for a long period of time.
- The main stages of research activity when planning and undertaking a case study; the crucial stages are: defining the case; selecting the case(s); collecting and analyzing the data; interpreting data; and reporting the findings.

Narrative/discourse and visual methodologies

- Narrative/discourse methods can be considered "real world measures" that are appropriate when "real life problems" are investigated.
- A "fully developed" narrative may include clauses or sets of clauses with the following functions, often roughly in this order: 1) Abstract, 2) Orientation, 3) Complicating action, 4) Result or resolution, 5) Evaluation, 6) Coda.
- Visual Methodologies is an indispensable resource for anyone working with visual materials.

- Visual methodologies are used to understand and interpret images and include photography, film, video,painting, drawing, collage, sculpture, artwork, graffiti, advertising, and cartoons.

Mixed method

- A mixed method combines both qualitative and quantitative elements to produce a better research quality by eliminating the biases inherent to either quantitative or qualitative methods alone.
- Mixed methods can be an ideal technique to assess complex interventions such as: 1) Validate findings using quantitative and qualitative data sources. 2) Use qualitative data to explore quantitative findings. 3) Develop survey instruments. 4) Use qualitative data to augment a quantitative outcomes study. 5) Involve community-based stakeholders.

Themes, coding and presentation

- Theme is used as attribute, descriptor, element, and concept. As an implicit topic that organizes a group of repeating ideas, it enables researchers to answer the study question.
- The four phases of theme development: “initialization”, “construction”, “rectification”, and “finalization”.
- A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data.
- Coding as the process of data reduction is an element of data organization in most qualitative approaches.
- Presentation refers to the organization of data into tables, graphs or charts, so that logical and statistical conclusions can be derived from the collected measurements.
- Qualitative data may be of the following type for presentation: a) Subjective b) Interpretative c)Descriptive d) Holistic e)Copious.

4.9 Unit End Exercises

1. State different research paradigms and discuss the evolution of the qualitative research.

2. What do you mean by the 'Grounded Theory'?
3. In which research situation the 'Grounded Theory' is better option and explains it in brief.
4. Discuss the research design of the 'Grounded Theory'.
5. What do you mean by Ethnographic studies of and in Education?
6. Briefly discuss the research design of the Case study approach.
7. What are Narrative/discourse Researches?
8. How does visual methodology contribute in the qualitative research process?
9. What do you mean by 'themes' in the qualitativeresearch?
10. What is coding? What are the importances of coding in the qualitative research?
11. What is the Mixed Method of Research? How is it meaningful in the qualitative research?
12. How does presentation play a great role in the qualitative research?

4.10 References

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Unit- 5 Preparing Research Proposal & Report

Structure

5.1 Introduction

Academic research proposals are generally written as part of the initial requirements of writing a thesis, research paper, or dissertation. They generally follow the same format as a research paper, with an introduction, a literature review, a discussion of research methodology and goals, and a conclusion. This basic structure may vary between projects and between fields, each of which may have its own requirements. The goal of a research proposal is twofold: to present and justify the need to study a research problem and to present the practical ways in which the proposed study should be conducted. The design elements and procedures for conducting research are governed by standards of the predominant discipline in which the problem resides; therefore, the guidelines for research proposals are more exacting and less formal than a general project proposal. Research proposals contain extensive literature reviews. They must provide persuasive evidence that a need exists for the proposed study. In addition to providing a rationale, a proposal describes detailed methodology for conducting the research consistent with requirements of the professional or academic field and a statement on anticipated outcomes and/or benefits derived from the study's completion. A proposal should contain all the key elements involved in designing a completed research study, with sufficient information that allows readers to assess the validity and usefulness of your proposed study. The only elements missing from a research proposal are the findings of the study and your analysis of those findings. Finally, an effective proposal is judged on the quality of your writing and, therefore, it is important that your proposal is coherent, clear, and compelling. A research proposal is a document proposing a research project, generally in the sciences or academia, and generally

constitutes a request for sponsorship of that research. Proposals are evaluated on the cost and potential impact of the proposed research, and on the soundness of the proposed plan for carrying it out.

The next part is presenting your proposal that requires skills and competence on the part of the presenter/researcher. The unit discusses further on this aspect, the technical know-how of presentation. After completion of the research, then comes thesis/dissertation writing, as the case may be. The subsequent section of this unit clearly deals with the components and chapters of writing in details. The unit further deals with the nitty gritties of writing technical papers or communication in a journal. The points to remember and to be considered when thought of writing an academic paper has been also thoroughly discussed here. Lastly the recent updates and knowledge on research management has been dealt precisely.

5.2 Objectives

After reading this Unit, the learners will be able to-

- Gain an understanding of different components of research proposal
- Acquire skills in presentation of research proposal
- Get hold of the competence required for writing thesis/dissertation
- Attain knowledge and ability to write technical paper for publication
- Acquaint and comprehend the concept of research management

5.3 Components of research proposal

5.3.1 Meaning of Research Proposal:

A proposal is a request for support for sponsored research, instruction, or extension projects. Research proposals may be solicited, meaning that they are submitted in response to a request with specified requirements, such as a request for proposal, or they may be unsolicited, meaning they are submitted without prior request. Other types of proposals include “pre-proposals”, where a letter of intent or brief abstract is submitted for review prior to submission of a full proposal; continuation proposals, which re-iterate an original proposal and its funding requirements in order to ensure continued funding; and renewal proposals, which seek continued sponsorship of a project which would otherwise be terminated.

Academic research proposals are generally written as part of the initial requirements of writing a thesis, research paper, or dissertation. They generally follow the same

format as a research paper, with an introduction, a literature review, a discussion of research methodology and goals, and a conclusion. This basic structure may vary between projects and between fields, each of which may have its own requirements (Wikipedia).

Research proposals generally address several key points:

i. What research question(s) will be addressed, and how they will be addressed

ii. How much time and expense will be required for the research

iii. What prior research has been done on the topic

iv. How the results of the research will be evaluated

v. How the research will benefit the sponsoring organization/stakeholder/discipline

Good proposals quickly and easily answer the following questions:

i. What do you want to do, and how do you plan to do it?

ii. How much will it cost, and how much time will it take?

iii. How does the proposed project relate to the sponsor's/stakeholder's interests?

iv. What difference will the project make to: your university, your students, your discipline, the state, the nation, or any other concerned parties?

v. What has already been done in the area of your project? Why should you, rather than someone else, do this project?

vi. How will the results be evaluated?

Certain questions will be emphasized over others depending on the nature of the proposed project and the agency to which you are submitting the proposal. Most agencies provide detailed instructions or guidelines concerning the preparation of proposals (and, in some cases, forms on which proposals are to be typed). (Open Source:https://guides.library.illinois.edu/c.php?g=504643&p=3454882)

So, let's take a look at what a research proposal is. When someone is interested in obtaining support for research, they often write a research proposal. These proposals are intended to convince people that your ideas and projects are important. They strive to explain how you can satisfactorily complete the project. A research proposal needs to let people know why the project is a good and/or needed idea and that you understand what information and studies are already out there. Keep in mind that the way the proposal is written is also important, as grammar, structure,

and content can make a difference in whether or not the proposal is accepted or rejected.

5.3.2 Determining the Proposal Type

Solicited proposals

Proposals submitted in response to a specific call issued by a sponsor. Such solicitations, typically called Request for Proposals (RFP), or Request for Quotations (RFQ), are usually have specific requirements for format and technical content, and may specify certain award terms and conditions. Broad Agency Announcements (BAAs) are not considered formal solicitations.

Unsolicited proposals

Proposals submitted to a sponsor that has not issued a specific solicitation but is believed by the investigator to have an interest in the subject.

Pre-proposals

These are requested by a sponsor who wants to minimize an applicant's effort in preparing a full proposal. Pre-proposals are usually in the form of a letter of intent or brief abstract. After the preproposal is reviewed, the sponsor notifies the investigator if a full proposal is warranted.

Continuation or non-competing proposals

These confirm the original proposal and funding requirements of a multi-year project which the sponsor has already provided funding for an initial period (normally one year). Continued support is usually dependent on satisfactory work progress and the availability of funds.

Renewal or competing proposals

These requests—from the sponsor's viewpoint—generally have the same status as an unsolicited proposal.

5.3.3 Primary Components of a Research Proposal

Proposals for sponsored activities generally follow a similar format; variations depend upon whether the proposer is seeking support for a research grant, a training grant, or a conference or curriculum development project. The following outline covers the primary components of a research proposal. Your proposal will be a variation on this basic theme.

Title Page:

Most sponsoring agencies specify the format for the title page, and some provide special forms to summarize basic administrative and fiscal data for the project. Titles are brief but comprehensive enough to indicate the nature of the proposed work.

Abstract:

The funder may use the abstract to make preliminary decisions about the proposal. Therefore, an effective summary states the problem addressed by the applicant, identifies the solution, and specifies the objectives and methods of the project. This summary should also outline funding requirements and describe the applicant's ability.

Table of Contents:

Brief proposals with few sections usually do not need a table of contents. Long and detailed proposals may require, in addition to a table of contents, a list of illustrations (or figures) and a list of tables. If all of these sections are included, they should follow the order mentioned, and each should be numbered with lower-case Roman numerals. The table of contents lists all major parts and divisions, including the abstract.

Introduction (including Statement of Problem, Purpose of Research, and Significance of Research, Terms & Concepts defined):

The introduction of a proposal begins with a capsule statement and then proceeds to introduce the subject to a stranger. It should give enough background to enable an informed lay person to place your particular research problem in a context of common knowledge and should show how its solution will advance the field or be important for some other work. The statement describes the significance of the problem(s), referring to appropriate studies or statistics.

Background (including Literature Survey):

Be sure to

(1) make clear what the research problem is and exactly what has been accomplished;

(2) to give evidence of your own competence in the field; and

(3) to show why the previous work needs to be continued. The literature review should be selective and critical. Discussions of work done by others should

lead the reader to a clear idea of how you will build upon past research and also how your work differs from theirs.

Description of Proposed Research (including Method or Approach):

The comprehensive explanation of the proposed research is addressed to other specialists in your field. This section is the heart of the proposal and is the primary concern of the technical reviewers. Remember as you lay out the research design to:

i. Be realistic about what can be accomplished.

ii. Be explicit about any assumptions or hypotheses the research method rests upon.

iii. Be clear about the focus of the research.

iv. Be as detailed as possible about the schedule of the proposed work.

v. Be specific about the means of evaluating the data or the conclusions.

vi. Be certain that the connection between the research objectives and the research method is evident.

vii. Spell out preliminary work developing an analytical method or laying groundwork as Phase 1.

viii. At the end of this phase you will be able to report that you have accomplished something and are ready to undertake Phase 2.

(Open Source:https://guides.library.illinois.edu/c.php?g=504643&p=3454882)

5.3.4 Description of Relevant Institutional Resources:

Generally this section details the resources available to the proposed project and, if possible, shows why the sponsor should select this University and investigator for this particular research. Some relevant points may be:

i. the institution's demonstrated skill in the related research area

ii. its abundance of experts in related areas that may indirectly benefit the project

iii. its supportive services that will directly benefit the project

iv. and the institution's unique or unusual research facilities or resources available to the project

List of References:

The style of the bibliographical item itself depends on the disciplinary field. The main consideration is consistency; whatever style is chosen should be followed carefully throughout the proposal.

The following two points are in case of Funding Projects:

Personnel:

This section usually consists of two parts: (1) an explanation of the proposed personnel arrangements and (2) the biographical data sheets for each of the main contributors to the project. The explanation should specify how many persons at what percentage of time and in what academic categories will be participating in the project. If the program is complex and involves people from other departments or colleges, make clear the organization of the staff and the lines of responsibility. Any student participation, paid or unpaid, should be mentioned, and the nature of the proposed contribution detailed. If any persons must be hired for the project, say so, and explain why, unless the need for persons not already available within the University is self-evident.

Budget:

Sponsors customarily specify how budgets should be presented and what costs are allowable. The budget lays out the costs to be met by the funding source, including personnel, non-personnel, administrative, and overhead expenses. The budget also specifies items paid for by other funding sources. This includes explanations for requested expenses.

5.3.5 Guidelines on writing a research proposal

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Introduction

This is a guide to writing M.A. research proposals. The same principles apply to dissertation proposals and to proposals to most funding agencies. It includes a model outline, but advisor, committee and funding agency expectations vary and your proposal will be a variation on this basic theme. You may use these guidelines as a point of departure for discussions with your advisor. They may serve as a straw-man against which to build your understanding both of your project and of proposal writing.

Proposal Writing

Proposal writing is important to your pursuit of a graduate degree or for any funding agency, where degree is not the objective. The proposal is, in effect, an intellectual scholastic (not legal) contract between you and your committee. It specifies what you will do, how you will do it, and how you will interpret the results. In specifying what will be done it also gives criteria for determining whether it is done. In approving the proposal, your committee gives their best judgment that the approach to the research is reasonable and likely to yield the anticipated results. They are implicitly agreeing that they will accept the result as adequate for the purpose of granting a degree. (Of course you will have to write the thesis in acceptable form, and you probably will discover things in the course of your research that were not anticipated but which should be addressed in your thesis, but the minimum core intellectual contribution of your thesis will be set by the proposal.) Both parties benefit from an agreed upon plan.

The objective in writing a proposal is to describe what you will do, why it should be done, how you will do it and what you expect will result. Being clear about these things from the beginning will help you complete your thesis in a timely fashion. A vague, weak or fuzzy proposal can lead to a long, painful, and often unsuccessful thesis writing exercise. A clean, well thought-out, proposal forms the backbone for the thesis itself. The structures are identical and through the miracle of word-processing, your proposal will probably become your thesis.

A good thesis proposal hinges on a good idea. Once you have a good idea, you can draft the proposal in an evening. Getting a good idea hinges on familiarity with the topic. This assumes a longer preparatory period of reading, observation, discussion, and incubation. Read everything that you can in your area of interest. Figure out what are the important and missing parts of our understanding. Figure out how to build/discover those pieces. Live and breathe the topic. Talk about it with anyone who is interested. Then just write the important parts as the proposal. Filling in the things that we do not know and that will help us know more: that is what research is all about.

Proposals help you estimate the size of a project. Don’t make the project too big. Our MA/ M.Ed program statement used to say that a thesis is equivalent to a published paper in scope. These days, sixty double spaced pages, with figures, tables and bibliography, would be a long paper. Your proposal will be shorter, perhaps five pages and certainly no more than fifteen pages. The merit of the

proposal counts, not the weight. Try to indicate to a relatively well-informed audience that you know the topic and how its logic hangs together, rather than fifteen or twenty pages that indicate that you have read a lot of things but not yet boiled it down to a set of prioritized linked questions.

In the abstract all proposals are very similar. They need to show a reasonably informed reader why a particular topic is important to address and how you will do it. To that end, a proposal needs to show how your work fits into what is already known about the topic and what new contribution your work will make. Specify the question that your research will answer, establish why it is a significant question, show how you are going to answer the question, and indicate what you expect we will learn. The proposal should situate the work in the literature, it should show why this is an (if not the most) important question to answer in the field, and convince your committee (the skeptical readers that they are) that your approach will in fact result in an answer to the question.

Theses which address research questions that can be answered by making plan-able observations (and applying hypothesis testing or model selection techniques) are preferred and perhaps the easiest to write. Because they address well-bounded topics, they can be very tight, but they do require more planning on the front end.

Literature review-based theses involve collection of information from the literature, distillation of it, and coming up with new insight on an issue. One problem with this type of research is that you might find the perfect succinct answer to your question on the night before (or after) you turn in the final draft — in someone else's work. This certainly can knock the wind out of your sails. (But note that even a straight-ahead science thesis can have the problem of discovering, late in the game, that the work you have done or are doing has already been done; this is where familiarity with the relevant literature by both yourself and your committee members is important.)

5.3.6 A Basic Proposal Outline:

i. Introduction

ii. Topic area

iii. Research question

iv. Significance to knowledge

v. Literature review

vi. Previous research of others & yours

vii. Interlocking findings and Unanswered questions

viii. Your preliminary work on the topic

ix. The remaining questions and inter-locking logic

x. Reprise of your research question(s) in this context

xi. Methodology

xii. Approach

xiii. Data needs

xiv. Analytic techniques

xv. Plan for interpreting results

xvi. Expected results

xvii. Budget

xviii. Bibliography (or References)

The Basic Thesis Outline

Each of these outlines is very similar. You probably see already that the proposal's organization lends itself to word-processing right into the final thesis. It also makes it easy for readers to find relevant parts more easily. The section below goes into slightly more detail on what each of the points in the outline is and does.

The Sections of the Proposal

The Introduction

Topic Area

A good title will clue the reader into the topic but it can not tell the whole story. Follow the title with a strong introduction. The introduction provides a brief overview that tells a fairly well informed (but perhaps non-specialist) reader what the proposal is about. It might be as short as a single page, but it should be very clearly written, and it should let one assess whether the research is relevant to their own. With luck it will hook the reader's interest.

What is your proposal about? Setting the topical area is a start but you need more, and quickly. Get specific about what your research will address.

Question

Once the topic is established, come right to the point. What are you doing? What specific issue or question will your work address? Very briefly (this is still the introduction) say how you will approach the work. What will we learn from your work?

Significance

Why is this work important? Show why this is it important to answer this question. What are the implications of doing it? How does it link to other knowledge? How does it stand to inform policy making? This should show how this project is significant to our body of knowledge. Why is it important to our understanding of the world? It should establish why I would want to read on. It should also tell me why I would want to support, or fund, the project.

Literature Review

State of our knowledge

The purpose of the literature review is to situate your research in the context of what is already known about a topic. It need not be exhaustive, it needs to show how your work will benefit the whole. It should provide the theoretical basis for your work, show what has been done in the area by others, and set the stage for your work.

In a literature review you should give the reader enough ties to the literature that they feel confident that you have found, read, and assimilated the literature in the field. It might do well to include a paragraph that summarizes each article's contribution, and a bit of 'mortar' to hold the edifice together, perhaps these come from your notes while reading the material. The flow should probably move from the more general to the more focused studies, or perhaps use historical progression to develop the story. It need not be exhaustive; relevance is 'key'.

Outstanding questions

This is where you present the holes in the knowledge that need to be plugged, and by doing so, situate your work. It is the place where you establish that your work will fit in and be significant to the discipline.

Research Questions in Detail

Tell what you have done so far. It might report preliminary studies that you have conducted to establish the feasibility of your research. It should give a sense that you are in a position to add to the body of knowledge.

Methodology

This section should make clear to the reader the way that you intend to approach the research question and the techniques and logic that you will use to address it.

Data Collection

This might include the field site description, a description of the instruments you will use, and particularly the data that you anticipate collecting. You may need to comment on site and resource accessibility in the time frame and budget that you have available, to demonstrate feasibility, but the emphasis in this section should be to fully describe specifically what data you will be using in your study. Part of the purpose of doing this is to detect flaws in the plan before they become problems in the research.

Data Analysis

This should explain in some detail how you will manipulate the data that you assembled to get at the information that you will use to answer your question. It will include the statistical or other techniques and the tools that you will use in processing the data. It probably should also include an indication of the range of outcomes that you could reasonably expect from your observations.

Interpretation

In this section you should indicate how the anticipated outcomes will be interpreted to answer the research question. It is extremely beneficial to anticipate the range of outcomes from your analysis, and for each know what it will mean in terms of the answer to your question.

Expected Results

This section should give a good indication of what you expect to get out of the research. It should join the data analysis and possible outcomes to the theory and questions that you have raised. It will be a good place to summarize the significance of the work.

It is often useful from the very beginning of formulating your work to write one page for this section to focus your reasoning as you build the rest of the proposal.

Bibliography

This is the list of the relevant works. Some advisors like exhaustive lists. Most fall in between: there is no reason to cite irrelevant literature but it may be useful to keep track of it even if only to say that it was examined and found to be irrelevant.

Use a standard format. Order the references alphabetically, and use "flag" paragraphs as per the University's Guidelines.

Tips and Tricks

Read everything you can find in your area of interest. Take notes, and talk to your advisor about the topic. If your advisor won't talk to you, find another one or rely on 'the net' for intellectual interaction. Email has the advantage of forcing you to get your thoughts into written words that can be refined, edited and improved. It also gets time stamped records of when you submitted what to your advisor and how long it took to get a response.

Write about the topic a lot, and don't be afraid to tear up (delete) passages that just don't work. Often you can re-think and re-type faster than you can edit your way out of a hopeless mess. The advantage is in the re-thinking.

Very early on, generate the research question, critical observation, interpretations of the possible outcomes, and the expected results. These are the core of the project and will help focus your reading and thinking. Modify them as needed as your understanding increases.

Use some systematic way of recording notes and bibliographic information from the very beginning. The classic approach is a deck of index cards. You can sort, regroup, layout spatial arrangements and work on the beach. Possibly a slight improvement is to use a word-processor file that contains bibliographic reference information and notes, quotes etc. that you take from the source. This can be sorted, searched, diced and sliced in your familiar word-processor. You may even print the index cards from the word-processor if you like the ability to physically re-arrange things.

Even better for some, is to use specialized bibliographic database software.

The balance between Introduction and Literature Review needs to be thought out. The reader will want to be able to figure out whether to read the proposal. The literature review should be sufficiently inclusive that the reader can tell where the bounds of knowledge lie. It should also show that the proposer knows what has been done in the field (and the methods used).

5.3.7 Example Format:

Another Sample of Research Proposal includes the following:

1. Introduction: Provides reader with a broad overview of problem in context.

2. Statement of problem: Answers the question, "What research problem are you going to investigate?"

3. Literature review: Shows how your approach builds on existing research; helps you identify methodological and design issues in studies similar to your own; introduces you to measurement tools others have used effectively; helps you interpret findings; and ties results of your work to those who've preceded you.

4. Research design and methods: Describes how you'll go about answering your research questions and confirming your hypothesis(es). Lists the hypothesis(es) to be tested, or states research question you'll ask to seek a solution to your research problem. Include as much detail as possible: measurement instruments and procedures, subjects and sample size.

The research design is what you'll also need to submit for approval from the Institutional Review Board (IRB) or the Institutional Animal Care and Use Committee (IACUC) if your research involves human or animal subjects, respectively.

The Elements of A Proposal: It is discussed in the subsequent sections (Pajares, 2007):

I. Introduction And Theoretical Framework

A. "The introduction is the part of the paper that provides readers with the background information for the research reported in the paper. Its purpose is to establish a framework for the research, so that readers can understand how it is related to other research" (Wilkinson, 1991, p. 96).

B. In an introduction, the writer should

1. create reader interest in the topic,
2. lay the broad foundation for the problem that leads to the study,
3. place the study within the larger context of the scholarly literature, and
4. reach out to a specific audience. (Creswell, 1994, p. 42)

C. If a researcher is working within a particular theoretical framework/line of inquiry, the theory or line of inquiry should be introduced and discussed early, preferably in the introduction or literature review. Remember that the theory/ line of inquiry selected will inform the statement of the problem, rationale for the study, questions and hypotheses, selection of instruments, and choice of methods. Ultimately, findings will be discussed in terms of how they relate to the theory/line of inquiry that undergirds the study.

D. Theories, theoretical frameworks, and lines of inquiry may be differently handled in quantitative and qualitative endeavors.

1. "In quantitative studies, one uses theory deductively and places it toward the beginning of the plan for a study. The objective is to test or verify theory. One thus begins the study advancing a theory, collects data to test it, and reflects on whether the theory was confirmed or disconfirmed by the results in the study. The theory becomes a framework for the entire study, an organizing model for the research questions or hypotheses for the data collection procedure" (Creswell, 1994, pp. 87-88).

2. In qualitative inquiry, the use of theory and of a line of inquiry depends on the nature of the investigation. In studies aiming at "grounded theory," for example, theory and theoretical tenets emerge from findings. Much qualitative inquiry, however, also aims to test or verify theory, hence in these cases the theoretical framework, as in quantitative efforts, should be identified and discussed early on.

II. Statement of the Problem

A. "The problem statement describes the context for the study and it also identifies the general analysis approach" (Wiersma, 1995, p. 404).

B. "A problem might be defined as the issue that exists in the literature, theory, or practice that leads to a need for the study" (Creswell, 1994, p. 50).

C. It is important in a proposal that the problem stand out—that the reader can easily recognize it. Sometimes, obscure and poorly formulated problems are masked in an extended discussion. In such cases, reviewers and/or committee members will have difficulty recognizing the problem.

D. A problem statement should be presented within a context, and that context should be provided and briefly explained, including a discussion of the *conceptual or theoretical framework* in which it is embedded. Clearly and succinctly identify and explain the problem within the framework of the theory or line of inquiry that undergirds the study. This is of major importance in nearly all proposals and requires careful attention. It is a key element that associations such as AERA and APA look for in proposals. It is essential in all quantitative research and much qualitative research.

E. State the problem in terms intelligible to someone who is generally sophisticated but who is relatively uninformed in the area of your investigation.

F. Effective problem statements answer the question "Why does this research need to be conducted." If a researcher is unable to answer this question clearly and succinctly, and without resorting to hyperspeaking (i.e., focusing on problems of macro or global proportions that certainly will not be informed or alleviated by the study), then the statement of the problem will come off as ambiguous and diffuse.

G. For conference proposals, the statement of the problem is generally incorporated into the introduction; academic proposals for theses or dissertations should have this as a separate section.

III. Purpose of the Study

A. "The purpose statement should provide a specific and accurate synopsis of the overall purpose of the study" (Locke, Spirduso, & Silverman, 1987, p. 5). If the purpose is not clear to the writer, it cannot be clear to the reader.

B. Briefly define and delimit the specific area of the research. You will revisit this in greater detail in a later section.

C. Foreshadow the hypotheses to be tested or the questions to be raised, as well as the significance of the study. These will require specific elaboration in subsequent sections.

D. The purpose statement can also incorporate the *rationale* for the study. Some committees prefer that the purpose and rationale be provided in separate sections, however.

E. Key points to keep in mind when preparing a purpose statement.

1. Try to incorporate a sentence that begins with "The purpose of this study is . . ."

This will clarify your own mind as to the purpose and it will inform the reader directly and explicitly.

2. Clearly identify and define the central concepts or ideas of the study. Some committee Chairs prefer a separate section to this end. When defining terms, make a judicious choice between using descriptive or operational definitions.

3. Identify the specific method of inquiry to be used.

4. Identify the unit of analysis in the study.

IV. Review of the Literature

A. The review of the literature provides the background and context for the research problem. It should establish the need for the research and indicate that the writer is knowledgeable about the area" (Wiersma, 1995, p. 406).

B. The literature review accomplishes several important things.

1. It shares with the reader the results of other studies that are closely related to the study being reported (Fraenkel & Wallen, 1990).

2. It relates a study to the larger, ongoing dialogue in the literature about a topic, filling in gaps and extending prior studies (Marshall & Rossman, 1989).

3. It provides a framework for establishing the importance of the study, as well as a benchmark for comparing the results of a study with other findings.

4. It "frames" the problem earlier identified.

C. Demonstrate to the reader that you have a comprehensive grasp of the field and are aware of important recent substantive and methodological developments.

D. Delineate the "jumping-off place" for your study. How will your study refine, revise, or extend what is now known?

E. Avoid statements that imply that little has been done in the area or that what has been done is too extensive to permit easy summary. Statements of this sort are usually taken as indications that the writer is not really familiar with the literature.

F. In a proposal, the literature review is generally brief and to the point. Be judicious in your choice of exemplars—the literature selected should be pertinent and relevant (APA, 2001). Select and reference only the more appropriate citations. Make key points clearly and succinctly.

G Committees may want a section outlining your *search strategy*—the procedures you used and sources you investigated (e.g., databases, journals, test banks, experts in the field) to compile your literature review. Check with your Chair.

V. Questions and/or Hypotheses

A. *Questions* are relevant to normative or census type research (How many of them are there? Is there a relationship between them?). They are most often used in qualitative inquiry, although their use in quantitative inquiry is becoming more prominent. *Hypotheses* are relevant to theoretical research and are typically used only in quantitative inquiry. When a writer states hypotheses, the reader

is entitled to have an exposition of the theory that led to them (and of the assumptions underlying the theory). Just as conclusions must be grounded in the data, hypotheses must be grounded in the theoretical framework.

B. A *research question* poses a relationship between two or more variables but phrases the relationship as a question; a *hypothesis* represents a declarative statement of the relations between two or more variables (Kerlinger, 1979; Krathwohl, 1988).

C. Deciding whether to use questions or hypotheses depends on factors such as the purpose of the study, the nature of the design and methodology, and the audience of the research (at times even the taste and preference of committee members, particularly the Chair).

D. The practice of using hypotheses was derived from using the scientific method in social science inquiry. They have philosophical advantages in statistical testing, as researchers should be and tend to be conservative and cautious in their statements of conclusions (Armstrong, 1974).

E. Hypotheses can be understood in four kinds of statements.

1. *Literary null*—a "no difference" form in terms of theoretical constructs. For example, "There is no relationship between support services and academic persistence of nontraditional-aged college women." Or, "There is no difference in school achievement for high and low self-regulated students."

2. *Operational null*—a "no difference" form in terms of the operation required to test the hypothesis. For example, "There is no relationship between the number of hours nontraditional-aged college women use the student union and their persistence at the college after their freshman year." Or, "There is no difference between the mean grade point averages achieved by students in the upper and lower quartiles of the distribution of the Self-regulated Inventory." *The operational null is generally the preferred form of hypothesis-writing*.

3. *Literary alternative*—a form that states the hypothesis you will accept if the null hypothesis is rejected, stated in terms of theoretical constructs. In other words, this is usually what you hope the results will show. For example, "The more that nontraditional-aged women use support services, the more they will persist academically." Or, "High self-regulated students will achieve more in their classes than low self-regulated students."

4. *Operational alternative*—Similar to the literary alternative except that the operations are specified. For example, "The more that nontraditional-aged college women use the student union, the more they will persist at the college after their freshman year." Or, "Students in the upper quartile of the Self-regulated Inventory distribution achieve significantly higher grade point averages than do students in the lower quartile."

F. In general, the null hypothesis is used if theory/literature does not suggest a hypothesized relationship between the variables under investigation; the alternative is generally reserved for situations in which theory/research suggests a relationship or directional interplay.

G. Be prepared to interpret any possible outcomes with respect to the questions or hypotheses. It will be helpful if you visualize in your mind, eye the tables (or other summary devices) that you expect to result from your research (Guba, 1961).

H. Questions and hypotheses are testable propositions deduced and *directly derived from theory* (except in grounded theory studies and similar types of qualitative inquiry).

I. Make a clear and careful distinction between the dependent and independent variables and be certain they are clear to the reader. *Be excruciatingly consistent in your use of terms.* If appropriate, use the same pattern of wording and word order in all hypotheses.

VI. The Design—Methods and Procedures

A. The methods or procedures section is really the heart of the research proposal. The activities should be described with as much detail as possible, and the continuity between them should be apparent" (Wiersma, 1995, p. 409).

B. Indicate the methodological steps you will take to answer every question or to test every hypothesis illustrated in the Questions/Hypotheses section.

C. All research is plagued by the presence of confounding variables (the *noise* that covers up the information you would like to have). Confounding variables should be minimized by various kinds of *controls* or be estimated and taken into account by randomization processes (Guba, 1961). In the design section, indicate

1. the variables you propose to control and how you propose to control them, experimentally or statistically, and
2. the variables you propose to randomize, and the nature of the randomizing unit (students, grades, schools, etc.).

D. Be aware of possible sources of error to which your design exposes you. You will not produce a perfect, error free design (no one can). However, you should anticipate possible sources of error and attempt to overcome them or take them into account in your analysis. Moreover, you should disclose to the reader the sources you have identified and what efforts you have made to account for them.

E. **Sampling**

1. The key reason for being concerned with sampling is that of *validity*—the extent to which the interpretations of the results of the study follow from the study itself and the extent to which results may be generalized to other situations with other people (Shavelson, 1988).
2. Sampling is critical to *external validity*—the extent to which findings of a study can be generalized to people or situations other than those observed in the study. To generalize validly the findings from a sample to some defined population requires that the sample has been drawn from that population according to one of several *probability* sampling plans. By a *probability sample* is meant that the probability of inclusion in the sample of any element in the population must be given *a priori*. All probability samples involve the idea of *random sampling* at some stage (Shavelson, 1988). In experimentation, two distinct steps are involved.

   Random selection—participants to be included in the sample have been chosen at random from the same population. Define the population and indicate the sampling plan in detail.

   Random assignment—participants for the sample have been assigned at random to one of the experimental conditions.
3. Another reason for being concerned with sampling is that of *internal validity*—the extent to which the outcomes of a study result from the variables that were manipulated, measured, or selected rather than from other variables not systematically treated. Without probability sampling, error estimates cannot be constructed (Shavelson, 1988).

4. Perhaps the key word in sampling is *representative*. One must ask oneself, "How representative is the sample of the survey population (the group from which the sample is selected) and how representative is the survey population of the target population (the larger group to which we wish to generalize)?"
5. When a sample is drawn out of convenience (a nonprobability sample), rationale and limitations must be clearly provided.
6. If available, outline the characteristics of the sample (by gender, race/ethnicity, socioeconomic status, or other relevant group membership).
7. Detail procedures to follow to obtain informed consent and ensure anonymity and/or confidentiality.

F. **Instrumentation**

1. Outline the instruments you propose to use (surveys, scales, interview protocols, observation grids). If instruments have previously been used, identify previous studies and findings related to reliability and validity. If instruments have not previously been used, outline procedures you will follow to develop and test their reliability and validity. In the latter case, a pilot study is nearly essential.
2. Because selection of instruments in most cases provides the operational definition of constructs, this is a crucial step in the proposal. For example, it is at this step that a literary conception such as "self-efficacy is related to school achievement" becomes "scores on the Mathematics Self-Efficacy Scale are related to Grade Point Average." Strictly speaking, results of your study will be directly relevant only to the instrumental or operational statements (Guba, 1961).
3. Include an appendix with a copy of the instruments to be used or the interview protocol to be followed. Also include sample items in the description of the instrument.
4. For a mailed survey, identify steps to be taken in administering and following up the survey to obtain a high response rate.

G **Data Collection**

1. Outline the general plan for collecting the data. This may include survey administration procedures, interview or observation procedures. Include an explicit statement covering the field controls to be employed. If appropriate, discuss how you obtained *entré*.

2. Provide a general outline of the time schedule you expect to follow.

H. **Data Analysis**

1. Specify the procedures you will use, and label them accurately (e.g., ANOVA, MANCOVA, HLM, ethnography, case study, grounded theory). If coding procedures are to be used, describe in reasonable detail. If you triangulated, carefully explain how you went about it. Communicate your precise intentions and reasons for these intentions to the reader. This helps you and the reader evaluate the choices you made and procedures you followed.

2. Indicate briefly any analytic tools you will have available and expect to use (e.g., Ethnograph, NUDIST, AQUAD, SAS, SPSS, SYSTAT, KALEIDOGRAPH etc).

3. Provide a well thought-out rationale for your decision to use the design, methodology, and analyses you have selected.

VII. Limitations and Delimitations

A. A *limitation* identifies potential weaknesses of the study. Think about your analysis, the nature of self-report, your instruments, the sample. Think about threats to internal validity that may have been impossible to avoid or minimize—explain.

B. A *delimitation* addresses how a study will be narrowed in scope, that is, how it is bounded. This is the place to explain the things that you are not doing and why you have chosen not to do them—the literature you will not review (and why not), the population you are not studying (and why not), the methodological procedures you will not use (and why you will not use them). Limit your delimitations to the things that a reader might reasonably expect you to do but that you, for clearly explained reasons, have decided not to do.

VIII. Significance of the Study

A. Indicate how your research will refine, revise, or extend existing knowledge in the area under investigation. Note that such refinements, revisions, or extensions may have either substantive, theoretical, or methodological significance. Think pragmatically (i.e., cash value).

B. Most studies have two potential audiences: practitioners and professional peers. Statements relating the research to both groups are in order.

C. This can be a difficult section to write. Think about *implications*—how results of the study may affect scholarly research, theory, practice, educational interventions, curricula, counseling, policy.

D. When thinking about the significance of your study, ask yourself the following questions.

1. What will results mean to the theoretical framework that framed the study?
2. What suggestions for subsequent research arise from the findings?
3. What will the results mean to the practicing educator?
4. Will results influence programs, methods, and/or interventions?
5 Will results contribute to the solution of educational problems?
6. Will results influence educational policy decisions?
7. What will be improved or changed as a result of the proposed research?
8. How will results of the study be implemented, and what innovations will come about?

IX. References

A. Follow APA guidelines regarding use of references in text and in the reference list. Of course, your committee or discipline may require Chicago or MLA.

B. Only references cited in the text are included in the reference list; however, exceptions can be found to this rule. For example, committees may require evidence that you are familiar with a broader spectrum of literature than that immediately relevant to your research. In such instances, the reference list may be called a *bibliography*.

C. Some committees require that reference lists and/or bibliographies be "annotated," which is to say that each entry be accompanied by a brief description, or an abstract. Check with your committee Chair before the fact.

Appendixes

The need for complete documentation generally dictates the inclusion of appropriate appendixes in proposals (although this is generally not the case as regards conference proposals).

The following materials are appropriate for an appendix. Consult with your Research committee is required here.

i. Verbatim instructions to participants.

ii. Original scales or questionnaires. If an instrument is copyrighted, permission in writing to reproduce the instrument from the copyright holder or proof of purchase of the instrument.

iii. Interview protocols.

iv. Sample of informed consent forms.

v. Cover letters sent to appropriate stakeholders.

vi. Official letters of permission to conduct research.

5.4 Presentation of proposal

5.4.1 Meaning

A proposal presentation has a distinct audience and purpose: Assume your audience to be: experts in your field of study; generalists with exposure to your field of study. A proposal presentation has a distinct audience and purpose. You need to persuade/convince evaluators: that the project is worth doing; that you are capable of carrying it out. It can be achieved by helping your evaluators understand the motivation for your idea. Like,

- General: What is the problem? What is its (social, scientific) significance?
- Specific: How will you approach your research question? The following cues may help:
- Originality/Creativity/Innovation:
- Is your project novel? How is it related /compared to prior works?

  It is very necessary to be Realistic and not too Ambitious. You have to take care of the following areas:

1. Background of the Study

- Provide a clear overview of your research plan

2. Research Methods

- Propose pertinent experiments with good controls
- Explain your methods succinctly

3. Expected Outputs

- Demonstrate the kind of data you might see
- Show how data will illuminate your central question

4. Alternative solutions/backup plans (Atissa Banuazizi,2012)

5.4.2 Goals for your presentation

- Convince audience that project is worth doing
- Convince audience that you can do it
- Assume that your audience comprises:
- experts in your topic
- intelligent non-experts with exposure to your field

5.4.3 Components of the presentation

- brief project overview
- sufficient background information for everyone to understand your proposal
- statement of the research problem and goals
- project details and methods
- predicted outcomes if everything goes according to plan and if nothing does
- needed resources to complete the work
- societal impact if all goes well

5.4.4: Preparedness: According to Angela et al, 2007 the following considerations are a must for preparing yourself for the presentation:

1. Questions to ask yourself about the presentation

- Does our talk fit together as a coherent whole?
- Are all sections of the talk adequately developed?
- Do we have a focused, well-defined hypothesis?
- Is it clear what is going to be done and how?
- Have we realistically articulated the scope of the work?
- Have we omitted extraneous material?
- Will our project fire up an audience's interest?

- What might make this proposal more convincing to a funding body? (In case of funding proposals)

2. Questions to ask yourselves about slide design

- Is everything on the slide readable?
- Are our slides a good balance of text and figures?
- Have we chosen clear, specific titles that express the main point of each slide?
- Is the design/format of our slides consistent, or were they obviously designed by different people?

3. Questions to ask yourself about delivery

- Can we get through our whole presentation in 10 minutes?
- Do we know where to position ourselves, and how to coordinate our shifts smoothly?
- Do our speaking styles work well together?
- Are we making the transitions between topics and speakers clear to the audience?

4. The five (5) truths of effective presentations:

i. the slides are not the presentation –YOU ARE!

ii. use the principles of visual design

iii. tell stories through images, not words (7 words, 7 lines)

iv. don't fumble with technology

v. rehearse, rehearse, rehearse

5. The essential principle of visual design

A. Colour: Brighter colours are visually heavier; Earth coloursare visually lighter; Use simple colour combinations (contrasting colours).

B. Text: Use a neutral typeface (Verdana, Helvetica, Candara, Geneva, Calibri, Comic Sans).It needs to be BIG. Tell the Stories with Images, not Words. Images do a better job in creating a relationship between the audience and the presentation. Don't Fumble with Technology. This is when great talks and nicely designed slides can go terribly wrong. The more you can visually connect with your audience, the more they will hear what you have to say.

6. Questions to ask yourself about slide design:

- Is everything on the slide readable?
- Are my slides a good balance of text and figures?
- Have I chosen clear, specific titles that express the main point of each slide?
- Is the design/format of my slides consistent?

7. Questions to ask yourself about delivery:

- Can I get through my whole presentation in 10 minutes?
- Do I know where to position myself?
- Am I making the transitions between topics clear to the audience?

5.4.5 Some more guidelines:

- Familiarize yourself with material (be prepared!)
- Note timing of the talk
- Aim for similar speaking styles
- Engage audience/evaluators
- Practice Q&A
- Come early on the day of the presentation '**(Locks & Sifuentes, 2009)**

Other Indicators:

- be nice to people; it is such a small world.
- remember, funders are partners-bear in mind the 'Track Record' thing
- update your CV every now and then
- be ready anytime, all the time, with your proposal and presentation
- consider building a research team and network
- good written and spoken English grammar

5.5 Writing of thesis/dissertation

5.5.1: Meaning of thesis & Dissertation:

A **dissertation** is a long formal piece of writing on a particular subject, especially for a university (Graduate/Post Graduate) degree. A thesis is an idea or theory that

is expressed as a statement and is discussed in a logical way. A **thesis** is a long piece of writing based on your own ideas and research that you do as part of a university degree, especially a higher degree such as a PhD. A thesis is a long essay or dissertation involving personal research, written by a candidate for a doctoral degree. A thesis statement focuses your ideas into one or two sentences. It should present the topic of your paper and also make a comment about your position in relation to the topic. Your thesis statement should tell your reader what the paper is about and also help guide your writing and keep your argument focused. There are definite differences between the two terms, though they are sometimes used interchangeably and often confused. Both papers are similar in their structure, as they contain an introduction, literary review, body, conclusion, bibliography/reference and appendix. Beyond that, the similarities basically end. Let's delve further into the definition of each and the differences between them.

The main difference between a thesis and a dissertation is when they are completed. The dissertation is a project that marks the end of a master's program, while the thesis occurs during doctoral study. The two are actually quite different in their purpose, as well. A dissertation is a compilation of research that proves you are knowledgeable about the information learn throughout your graduate program. A thesis is your opportunity during a doctorate program to contribute new knowledge, theories or practices to your field. The point is to come up with an entirely new concept, develop it and defend its worth.

5.5.2 Guidelines for Writing a Thesis or Dissertation (Linda Childers Hon, 2007-08)

Most research begins with a question. Think about which topics and theories you are interested in and what you would like to know more about. Think about the topics and theories you have studied in your program. Is there some question you feel the body of knowledge in your field does not answer adequately? Once you have a question in mind, begin looking for information relevant to the topic and its theoretical framework. Read everything you can—academic research, trade literature, and information in the popular press and on the Internet. As you become well-informed about your topic and prior research on the topic, your knowledge should suggest a purpose for your thesis/dissertation. When you can articulate this purpose clearly, you are ready to write your proposal. This document specifies the purpose of the study, significance of the study, a tentative review of the literature on the topic and its theoretical framework (a working bibliography should be attached), your research questions and/or hypotheses, and how you will collect and analyze

your data (your proposed instrumentation should be attached). Once your instrumentation is developed, you need to clear it and your informed consent protocol with the Institutional Review Board/Departmental Research Committee/ before you begin collecting data. Leave adequate time to do so. The process can take several days or weeks. Obviously, the next steps are collecting and analyzing data, writing up the findings, and composing the final chapter. You also should make sure Chapters 1 and 2 are now fully developed. Your chair and committee members provide guidance as needed at this point but expect you to work as independently as possible. You should be prepared to hire assistance with coding and data entry and analysis if needed. Get a copy of the DRC/ PhD guidelines for writing theses and dissertations and follow these guidelines exactly.

5.5.3 Writing

Each thesis or dissertation is unique but all share several common elements. The following is not an exact guide but rather a general outline**.**

Chapter 1: Introduction/Background, Purpose and Significance of the Study

In the first chapter, clearly state what the purpose of the study is and explain the study's significance. The significance is addressed by discussing how the study adds to the theoretical body of knowledge in the field and the study's practical significance for communication professionals in the field being examined. Ph.D. students also must explain how their research makes an original contribution to the body of knowledge in their discipline. They also should address the significance of the study for mass communication education. It is especially critical that this chapter be well developed. Without a clearly defined purpose and strong theoretical grounding, the thesis or dissertation is fundamentally flawed from the outset. 3

Chapter 2: Review of the Literature

The purpose of the study should suggest some theoretical framework to be explained further in this chapter. The literature review thus describes and analyzes previous research on the topic.

This chapter, however, should not merely string together what other researchers have found. Rather, you should discuss and analyze the body of knowledge with the ultimate goal of determining what is known and is not known about the topic. This determination leads to your research questions and/or hypotheses. In some cases, of course, you may determine that replicating previous research is needed.

Chapter 3: Methodology

This chapter describes and justifies the data gathering method used. This chapter also outlines how you analyzed your data. Begin by describing the method you chose and why this method was the most appropriate. In doing so, you should cite reference literature about the method.

Next, detail every step of the data gathering and analysis process. Although this section varies depending on method and analysis technique chosen, many of the following areas typically are addressed:

- description of research design internal validity external validity
- description of population and description of and justification for type of sample used or method for selecting units of observation
- development of instrument or method for making observations (e.g., question guide, categories for content analysis)

pre-test

reliability and validity of instrument or method

- administration of instrument or method for making observations (e.g., interviews, observation, content analysis)
- coding of data
- description of data analysis
- statistical analysis and tests performed
- identification of themes/categories (qualitative or historical research)

Chapter 4: Findings

This chapter addresses the results from your data analysis only. This chapter does not include discussing other research literature or the implications of your findings. Usually you begin by outlining any descriptive or exploratory/confirmatory analyses (e.g., reliability tests, factor analysis) that were conducted. You next address the results of the tests of hypotheses. You then discuss any ex post facto analysis. Tables and/or figures should be used to illustrate and summarize all numeric information.

For qualitative and historical research, this chapter usually is organized by the themes or categories uncovered in your research. If you have conducted focus groups or interviews, it is often appropriate to provide a brief descriptive (e.g.,

demographic) profile of the participants first. Direct quotation and paraphrasing of data from focus groups, interviews, or historical artifacts then are used to support the generalizations made. In some cases, this analysis also includes information from field notes or other interpretative data (e.g., life history information).

Chapter 5: Discussion

The purpose of this chapter is not just to reiterate what you found but rather to discuss what your findings mean in relation to the theoretical body of knowledge on the topic and your profession. Typically, students skimp on this chapter even though it may be the most important one because it answers the "So what?" question.

Begin by discussing your findings in relation to the theoretical framework introduced in the literature review. In some cases, you may need to introduce new literature (particularly with qualitative research).

This chapter also should address what your findings mean for communication professionals in the field being examined. In other words, what are the study's practical implications?

Doctoral students also should discuss the pedagogical implications of the study. What does the study suggest for mass communication education? This chapter next outlines the limitations of the study. Areas for future research then are proposed. Obviously, the thesis or dissertation ends with a brief conclusion that provides closure. A strong final sentence should be written.

Drawing concluding remarks/Finishing:

The defense is scheduled when the thesis has been completed successfully—not when it is convenient for the student to graduate. Even if nothing goes wrong (and things often do), a quality thesis takes about six to nine months to complete (from inception to graduate school clearance).

Obviously, the same principles apply for dissertations as well but doctoral students must allot even more time. A quality dissertation usually takes about a year to complete (best case scenario).

Do not expect your chair or committee members to copy edit your thesis or dissertation. Before turning in any drafts, you should carefully edit and spell checks your work. Editing occurs at two different levels at least. Micro editing involves correcting spelling and grammatical errors. It also involves checking for proper paragraph and sentence structure, consistent use of terms, and variety in word choice.

Macro editing assesses the overall structure of the thesis. This includes making sure each chapter flows logically from the previous chapter, headings and subheadings are used properly and consistently, and transitions are included between major topics. Macro editing also determines whether any parts of the thesis need to be streamlined or expanded. In some cases, it may be necessary for you to hire a professional editor.

Leave time for the Chair/Guide/Supervisor to read your completed thesis or dissertation at least twice before giving it to your committee members. Don't expect to submit the completed thesis or dissertation for the first time to the chair and defend in the same or following week. Also, it is customary to give the thesis or dissertation to committee members at least a week before the defense. It is the student's responsibility to reserve a room for the defense and to bring the signature page and the examination form to the defense. Be prepared for revisions after the defense. You can expedite clearance by the graduate school by letting the staff examine a draft of the thesis or dissertation before you defend. It is customary to provide your chair and committee members with a bound copy of the final version of the thesis or dissertation (Kent, 2001).

5.5.4 Outline for Empirical Master's Theses: An example is cited and discussed below:

Chapter I. INTRODUCTION.

A. Broad introduction to thesis topic and method. Page or two. Write after remainder of proposal is completed.

B. Research problem. State broadly, in question form. Give sub-questions. Explain carefully. In one sense, usually the problem is to expand the body of knowledge examined in the literature review.

C. Need for the research. Who will benefit? Discuss applied and scientific contributions.

D. Nominal definitions. Define central terms.

E. Context. Add further info to clarify the research problem.

Chapter II. THEORY. Literature review. Organize by idea; avoid stringing together abstracts of articles.

A. Overview. Theoretical foundations.

B. Literature. Group articles by ideas. For a given idea, first discuss common strands in the literature, then departures.

C. Model. Of a process, usually. Based on the lit reviewed.

D. Hypotheses (in broad sense of the term; also called Propositions). For each, give brief restatement of justification tied to earlier sections; explain derivation and implications. Include assumptions. Explicitly state plausible rival hypotheses (explanations of process) of a substantive nature.

E. Scope of the study. Theoretical assumptions; discuss limitations they impose.

Chapter III. METHODS. Outline in a few pages.

A. Introduction. General description of method and design.

B. Design. Experiment, quasi-experiment, survey, and so forth. Detailed description.

C. Sample. Universe, population, element, sample design, tolerance, probability.

D. Measurement. Operational definitions. Include, as applicable, detailed discussion of indexes/ scales. Specify methods used to assess validity and reliability.

E. Analysis. Techniques to be used; justification. Nature of relationships expected (e.g., asymmetrical, symmetrical, reciprocal; linear, monotonic, other curvilinear; necessary, sufficient, necessary and sufficient). Include dummy tables and worked examples of statistics.

F. Validity. Design: Internal and external, with relevant subtypes.

G. Methodological assumptions. Discuss limitations they impose.

APPENDICES.

A. Schedule. In Gantt Chart form.

B. Facilities. Faculty and staff expertise, library and computer resources, other special facilities contributing to a successful study.

C. Budget.

D. Bibliographic essay. Sources searched (indexes, abstracts, bibliographies, etc.). Strengths and weaknesses of literature. 6

BIBLIOGRAPHY. Works cited in proposal, plus other relevant documents.

THESIS.

Chapters I-III. As in proposal, re-written and most likely expanded.

Chapter IV. FINDINGS.

A. Brief overview.

B. Results of application of method; any unusual situations encountered. Nature of sample.

C. Descriptive analysis. One-way frequency distributions on central variables.

D. Validity/reliability analysis.

E. Tests of hypotheses. ANOVAs, crosstabulations, correlations, and such, depending on techniques used; give in same order as hypotheses.

Chapter V. DISCUSSION. When discussing implications, deal with both the theoretical and the practical. Present only interpretations of the findings, not opinion.

A. Brief overview.

B. Discussion of results of application of method. Implications.

C. Discussion of descriptive analysis. Implications.

D. Discussion of tests of hypothesis. Implications.

E. Post-hoc analysis. Implications.

Chapter VI. CONCLUSION. May include writer's opinion.

A. Summary of entire thesis in a few pages.

B. Conclusions. Refer to lit review.

C. Implications. Speculate about broadest possible consequences, both theoretical and practical. Label speculation clearly.

D. Limitations. Theory, method.

E. Suggestions for future research.

APPENDICES. Bibliographic essay. Questionnaire and coding manual, if any. Raw data.

BIBLIOGRAPHY. Include all relevant sources examined, whether cited or not.

5.6 Writing technical paper for publication

5.6.1: Meaning of Technical Paper: Technical writing includes a wide range of documents. They include instructions, reviews, reports, newsletters, presentations, web pages, brochures, proposals, letters, fliers, graphics, memos, press releases, handbooks, specifications, style guides, agenda and so on.

Some people believe that writing papers, giving talks, and similar "marketing" activities are not part of research, but an adjunct to it or even an undesirable distraction. This view is inaccurate. The purpose of research is to increase the store of human knowledge, and so even the very best work is useless if you cannot effectively communicate it to the rest of the world. Additionally, writing papers and giving talks will clarify your thinking and thereby improve your research. You may be surprised how difficult it is to clearly communicate your ideas and contributions; doing so will force you to understand them more deeply and enable you to improve them.

5.6.2 Points to remember for start-ups:

A major problem that young researchers face is their inability to write good research papers. This document serves as a guideline on how to write a good technical paper. It contains ideas that have been gained through experience; skilled authors will find themselves familiar with these ideas. The document is formatted and structured like a typical journal publication. Each section describes what you should discuss in it. The abstract is what a person always reads first in a technical paper. Based on the content of the abstract, the reader will decide whether the paper is worthy enough to merit further study. The abstract should classify your research and contribution in the research areas. It should contain the following four parts: a brief introduction describing the discipline that the paper belongs to; a clear and concise statement of your problem; a brief explanation of your solution and its key ideas; a brief description of the results obtained and their impacts. Lastly, provide a short list of index keyword terms.

A primary task of a researcher is the communication of technical results to the broader scientific community. Whether in written or oral form, scientific communication is a critical step in the scientific method and is the key driver of movement within a scientific field. Therefore, the construction of a written scientific manuscript must not be taken lightly. As part of our service to the broader scientific community, we thought it may be beneficial to identify some of the common aspects of a well constructed scientific manuscript. These points are briefly discussed below.

It should be noted that manuscripts that are successfully submitted to a journal for publication have three main components:

i. the overall idea,

ii. the execution of the work, and

iii. the presentation of the work.

The general tips for all kinds of technical documentation are like that:

i. To get to know the audience. Your document should be clear and understandable for the audience it is aimed for. Writing for technical experts presupposes using more complicated terms and jargon. Lay audiences need more explanations.

ii. To make complex things simpler. Use a simple structure of the text. Use simple sentences instead of complex ones. Avoid lengthy words when it is possible.

iii. Use the graphical content: tables, schemes, diagrams. They all contribute to easy perception of the information and make things clear when we talk about data.

5.6.3 Background of writing a technical paper:

The goal of writing a paper is to change people's behavior: for instance, to change the way they think about a research problem or to convince them to use a new approach. Determine your goal (also known as your thesis), and focus the paper around that goal.

As a general rule, your paper needs to convince the audience of three key points:

i. that the problem is **interesting**,

ii. that it is **hard**, and

iii. that you **solved** it.

If any of these is missing or unclear, the paper will not be compelling. You'll also need to convince your readers that your contributions are novel. When expressing this, it may be helpful to explain why no one else thought of your approach before, and also to keep in mind how you expect the behavior of readers to change once they appreciate your contributions.

Details to include

Your purpose is to communicate specific ideas, and everything about your paper should contribute to this goal. If any part of the paper does not support your main point, then delete or change that part. You must be ruthless in cutting every irrelevant detail, however true it may be. Everything in your paper that does not support your main point distracts from it.

Write for the readers, rather than writing for yourself. In particular, think about what matters to the intended audience, and focus on that. It is not necessarily what you personally find most intriguing.

The audience is interested in what worked, and why, so start with that. If you discuss approaches that were not successful, do so briefly, and typically only after you have discussed the successful approach. Furthermore, the discussion should focus on differences from the successful technique, and if at all possible should provide general rules or lessons learned that will yield insight and help others to avoid such blind alleys in the future.

Whenever you introduce an inferior approach, say so upfront. A reader will (and should) assume that whatever you write in a paper is something you believe or advocate, unless very clearly marked otherwise. When there are multiple possible approaches to a problem, it is preferable to give the best or successful one first.

A paper should communicate the main ideas of your research (such as the techniques and results) early and clearly. Then, the body of the paper can expand on these points; a reader who understands the structure and big ideas can better appreciate the details.

Getting started: overcoming writer's block and procrastination

Some writers are overwhelmed by the emptiness of a blank page or editor buffer, and they have trouble getting started with their writing. Don't worry! Here are some tricks to help you get started. Once you have begun, you will find it relatively easier to revise your notes or first draft. The key idea is to write *something*, and you can improve it later.

Start verbally. Explain what the paper needs to say to another person. After the conversation is over, write down what you just said, focusing on the main points rather than every word you spoke. Many people find it easier to speak than to write. Furthermore, getting feedback and giving clarifications will help you discover problems with your argument, explanation, or word choice.

Outline. You may not be ready to write full English paragraphs, but you can decide which sections your paper will have and give them descriptive titles. Once you have decided on the section structure, you can write a little outline of each section, which indicates the subsection titles. Now, expand that into a topic sentence for each paragraph. At this point, since you know the exact topic of each paragraph, you will find the paragraph easy to write.

Stream-of-consciousness notes. Write down everything that you know, in no particular order and with no particular formatting. Afterward, organize what you wrote thematically, bringing related points together. Eventually, convert it into an outline and proceed as above. While writing notes, use phrases/keywords, *not* complete sentences. The phrases are quicker to write and less likely to derail your brainstorming; they are easier to organize; and you will feel less attached to them and more willing to delete them.

Brevity

Be brief. Make every word count. If a word does not support your point, cut it out, because it will be harder for the reader to appreciate your message. Use shorter and more direct phrases wherever possible. Make your writing crisp and to the point. Eliminate any text that does not support your point. You will need to repeat this entire process multiple times, keeping a fresh perspective on the paper.

Writing style

Passive voice has no place in technical writing. It obscures who the actor was, what caused it, and when it happened. Use active voice and simple, clear, direct phrasing. Avoid puffery, self-congratulation, and value judgments: give the facts and let the reader judge. Do not use words like “clearly”, “easily”, “obviously”, and “trivially”, Prefer singular to plural number. When describing an experiment or some other event or action that occurred in the past, use *past tense*. When describing the paper itself, use *present tense*. “This paper shows that ...”. The reason for this is that the reader is experiencing the paper in real time. Use “previous work” instead of “existing work”. Your work exists, so “existing work” would refer to it as well.Prefer unambiguous words to ambiguous ones. Never use “as” or “since” to mean “because”.

Figures

Different people learn in different ways, so you should complement a textual or mathematical presentation with a graphical one. Even for people whose primary learning modality is textual, another presentation of the ideas can clarify, fill gaps, or enable the reader to verify his or her understanding. Figures can also help to illustrate concepts, draw a skimming reader into the text (or at least communicate a key idea to that reader), and make the paper more visually appealing.

A figure should stand on its own, containing all the information that is necessary to understand it. Good captions contain multiple sentences; the caption provides

context and explanation. The flow of the writing is interrupted with details that are relevant only when one is looking at the figure.

Many writers label all the types of figures differently — some as "figure", others as "table" or "graph" or "picture". This differentiation has no benefits, but it does have a drawback: it is very hard for a reader to find "table 3", which might appear after "figure 7" but before "freehand drawing 1". You should simply call them all figures and number them sequentially. The body of each figure might be a table, a graph, a diagram, a screenshot, or any other content.

Any boldface or other highlighting should be used to indicate the most important parts of a text.

Naming/title of the Paper

Give each concept in your paper a descriptive name to make it more memorable to readers. Never use terms like "approach 1", "approach 2", or "our approach", and avoid acronyms when possible. If you cannot think of a good name, then quite likely you don't really understand the concept. Think harder about it to determine it's most important or salient features. It is better to name a technique (or a paper section, etc.) based on *what* it does rather than *how* it does it.

Do not use a single term to refer to multiple concepts. If you use the term "technique" for every last idea that you introduce in your paper, then readers will become confused. This is a place that use of synonyms to distinguish concepts that are unrelated (from the point of view of your paper) is acceptable. For instance, you might always use "phase" when describing an algorithm but "step" when describing how a user uses a tool.

Numbers and measurements: Do not report more digits of precision than the measurement process reliably and reproducibly produces.

Processing data

Your paper probably includes tables, bibliographies, or other content that is generated from external data. Your paper may also be written in any text formatting language. In each of these cases, it is necessary to run some external command to create some of the content or to create the final PDF.

All of the steps to create your final paper should be clearly documented — say, in comments or in a notes file that you maintain with the paper — and, preferably, should be automated so that you only have to run one command that collects all the data, creates the tables, and generates the final PDF.

Related work

A related work section should not only explain what research others have done, but in each case should compare and contrast that to your work and also to other related work. After reading your related work section, a reader should understand the key idea and contribution of each significant piece of related work, how they fit together and how your work differs. It is not advisable to write a related work section that is just a list of other papers, with a sentence about each one that was lifted from its abstract, and without any critical analysis or deep comparison to other work.

Just as you should generally explain your technique first, and later show relationships with other work, it is also usually more effective to defer a detailed discussion of limitations to a later section rather than the main description of your technique. You should be straightforward and honest about the limitations, of course (do mention them early on, even if you don't detail them then), but don't destroy the coherence of your narrative.

Feedback

Finish your paper well in advance, so that you can improve the writing. Even re-reading your own text after being away from it can show you things that you didn't notice. An outside reader can tell you even more.

When readers misunderstand the paper that is always at least partly the author's fault! Even if you think the readers have missed the point, you will learn how your work can be misinterpreted, and eliminating those ambiguities will improve the paper.

Be generous with your time when colleagues need comments on their papers: you will help them, you will learn what to emulate or avoid, and they will be more willing to review your writing.

Some of your best feedback will be from yourself, especially as you get more thoughtful and introspective about your writing. To take advantage of this, start writing early. One good way to do this is to write a periodic progress report that describes your successes and failures. The progress report will give you practice writing about your work, oftentimes trying out new explanations.

Whereas you should start writing as early as possible, you do not need to put that writing in the form of a technical paper. In fact, it's usually best to outline the technical paper, and get feedback on that, before you start to fill in the sections with text.

Points of Feedback:

- It can encourage you not to give sufficient context.
- It does not encourage putting related information together or important information first.
- You want to encourage all reviewers to read the entire response, rather than encouraging them to just look at one part.
- When multiple reviewers raised the same issue, then no matter where you address it, it's possible for a reviewer to overlook it and think you failed to address it.
- You don't want to make glaringly obvious which issues in a review you had to ignore (for reasons of space or other reasons).

In general, it's best not to mention reviewer names/numbers in your response at all. Make the response be about the process, not about the people.

Finally, be civil and thankful the reviewers. They have spent considerable time and energy to give you feedback and you should be grateful and courteous in return.

Rejection of Paper:

If you submit technical papers, you will experience rejection. In some cases, rejection indicates that you should move on and begin a different line of research. In most cases, the reviews offer an opportunity to improve the work, and so you should be very grateful for a rejection! It is much better for your career if a good paper appears at a later date, rather than a poor paper earlier or a sequence of weak papers.

Even small flaws or omissions in an otherwise good paper may lead to rejection. The wrong lesson to learn from rejection is discouragement or a sense of personal failure.

5.6.4 General Principles/Guidelines for writing technical Papers

1. Correctness. Write correct English, but know that you have more latitude than your high-school English teachers may have given you.
2. Consistent names. Refer to each significant character (algorithm, concept, language) using the same word everywhere. Give a significant new character a proper name.

3. Singular. To distinguish one-to-one relationships, refer to each item in the singular, not the plural.
4. Subjects and verbs. Put your important characters in subjects, and join each subject to a verb that expresses a significant action.
5. Information flow. In each sentence, move your reader from familiar information to new information.
6. Emphasis. For material you want to carry weight or be remembered, use the end of a sentence.
7. Coherence. In a coherent passage, choose subjects that refer to a consistent set of related concepts.
8. Parallel structure. Order your text so your reader can easily see how related concepts are different and how they are similar.
9. Abstract. In an abstract, don't enumerate a list of topics covered; instead, convey the essential information found in your paper.

Practices

1. Write in brief daily sessions. Ignore the common myth that successful writing requires large, uninterrupted blocks of time — instead, practice writing in brief, daily sessions.
2. Focus on the process, not the product.
3. Pre-write. Don't be afraid to think before you write, or even jot down notes, diagrams, and so on.
4. Use index to plan a draft or to organize or reorganize a large unit like a section or chapter.
5. Value writing a first draft always
6. Don't worry about page limits. Write the paper you want, and then cut it down to size.

5.6.5 Tips to Write and Publish an Academic Research Paper: At a glance

i. Get help. If you are performing research techniques for the first time, be sure to consult an experienced friend or colleague.

ii. Know what you want to study, WHY you want to study it, and how your results will contribute to the current pool of knowledge for the subject.

iii. Be able to clearly state a hypothesis before starting your work.

iv. While ideas are good to note, be sure to keep your focus.

v. Along with keeping focus, know your experimental endpoints. Sometimes data collection goes smoothly and you want to dig deeper and deeper into the subject. If you want to keep digging deeper, do it with a follow-up study.

vi. Keep in mind where you might like to publish your study. If you are aiming for a high-impact journal, you may need to do extensive research and data collection. If your goal is to publish in a lower-tier-journal, your research plan may be very different.

vii. Every Journal has its own "Instruction to authors" which needs to be followed strictly

viii. The Reference/Bibliography/webliography needs to be adhered to as per the demands or stipulation of the Journal you are intending to communicate your paper (Ernst, 2005)

Manuscripts submitted to journals for consideration for publication typically have the following components.

i. Title Page

ii. Abstract

iii. Introduction

iv. Methods

v. Results

vi. Discussion

vii. Conclusions

viii. Acknowledgements

ix. References

x. Tables and Table Captions

xi. Figure and Figure Caption

5.7 Research management

(Open Source: https://www.emeraldgrouppublishing.com/research/guides/management/index.htm)

Every academic discipline has its own area of research for enrichment and development in the greater academia. Whatever your discipline is, managing the day-to-day aspects of your research is a challenge. The following strategies would help you secure the resources and develop the skills you need to manage your research/ research project more effectively.

Social Media for academic research

Google chat, Face book, Twitter has, slightly unfairly, gained a reputation for being lightweight. Some tweets contain important information, and Twitter is used widely in most professions. For academics who engage with social media, it has become a valuable tool to help build both their network and their reputation, as well as to provide data.

Use of search engines effectively

The perfect search engine does not exist. Not only is information increasing exponentially, but search behaviour is becoming ever more demanding. So, at the point when theoretical perfection is achieved, another layer of information becomes available, and people find new ways to search.

Use of digital tools for research

Over the last ten years there has been an explosion of digital tools which can store, search and retrieve information. Digital technology offers the potential to hold and structure data in a more systematic way, combining and integrating data sets so that it is possible to cut through information overload, yielding greater understanding about ourselves, and the possibility for more targeted, relevant and cost-effective policymaking.

Develop research with impact

All researchers want their research to have impact – on other scholars, and on the world at large. Impact is also important for achieving tenure, promotion, merit rises, grants – and all the other enticing fruits on the research tree.

Use of social software tools for research

Researchers are using increasingly sophisticated tools to enable them to work more easily and productively; and it is gradually being realized that an appropriate electronic infrastructure, which can store data, facilitate collaboration and generally support research processes, is as important to researchers as it is to good libraries. This infrastructure is often referred to as a virtual research environment, or VRE.

Search of the right statistics resources

It intends the direction of books and websites on statistics. Note that these resources are not reviewed in the formal sense in that we do not attempt to make a qualitative judgement. We indicate the provenance (which should itself give you an idea of their quality) and coverage of websites, and, in the case of books, give bibliographic details and brief descriptions of their approach.

Guidelines to write a grant application

Because each proposal is unique, there is no one correct way to write one. What follows is a series of pointers, which should be read in conjunction with the particular advice given by the body from whom you are seeking funds.

Selection of a funding body

Applying for research funding is an increasingly complex, time-consuming and competitive business. For those who have entered academic life because they want to extend the frontiers of knowledge, it must be an infuriating task but not impossible.

Preparation of a proposal for a research degree

This point is not exclusively obtaining a PhD. PhD proposals have particular requirements which differ from those pertaining to other research situations, and they provide both a way of ensuring that the university matches the student's needs, and also a guidance document which will give shape and substance to the ensuing research.

To give a research presentation

Giving a presentation about your research is a very important skill for an academic. You will need to do it when defending your PhD, when outlining your current research at a job interview, when doing a presentation on your research at a conference, and when describing the research which you are hoping that a potential funder will provide funds for you.

To collaborate effectively

This aims to give you some hints and tips for collaborating on research and development projects. It doesn't deal with how to find partners in the first place. It is assumed you have to be about the nuts and bolts of the collaborating process.

To conduct research ethically

Ethical issues are assuming increasing importance in research, with most research proposals – even at undergraduate level – needing to be subject to their university's ethics committee and follow a particular code. This aims at what constitutes ethics in the context of management and social research, before exploring the various issues that come up throughout the research, from gaining access to an organization to disseminating the results.

To design a research study

You have chosen your research topic and refined your research question. Still very much at the planning stage, you must now decide which research techniques to employ. This deals with the most common – what are they, how are they used and which are most suitable for a particular study.

To find ideas for your research

With advice for undergraduate dissertations, PhD and post-PhD research, a well-focused research project with a strong rationale should pass the "so what" test at all stages, including when you are seeking to publish.

To manage the research process

You can make the process easier by applying the techniques of project management. It delineates at the particular characteristics of research which make it different from other projects, up-front planning and ongoing monitoring, and working with partners and funding bodies.

5.8 Let us sum up

The last unit of this paper discusses with finishing part of research documentation and writing technical paper to open up and share knowledge to the greater academia. The five subunits as envisaged in this unit namely focus on the elements of the research and its detail components. The next subunit deliberated upon the practical aspect of presenting the proposal before the concerned house. The third subunit encompasses the general and specific guidelines on writing thesis/dissertation. The

tips and tricks have been judiciously so that the aspirants can imbibe the necessary skills and acquire competencies to do the same. The fourth subunit enclaves on the technicalities surrounding writing a research paper for Journals. Here, you will come across the vital points to remember and consider while writing a technical paper. The last sub unit deals with the research management. This is comparatively an obscure area as it is conceived into different meanings. However notwithstanding, recent updates on research management is discussed with precision.

5.9 Unit End Exercises:

1. What is the meaning of Research Proposal?
2. Describe in brief the elements of Research Proposal
3. List the points/heading of writing of proposal.
4. What is the significance of Research Proposal?
5. What are the basic requirements for presentation of a research proposal?
6. Mention some of the visual alerts in PPT presentation?
7. Distinguish between thesis and dissertation.
8. Briefly discuss on the chapters earmarked in composing a thesis/dissertation.
9. What is a technical paper?
10. What are the areas of research management discussed?

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মানুষের জ্ঞান ও ভাবকে বইয়ের মধ্যে সঞ্চিত করিবার যে একটা প্রচুর সুবিধা আছে, সে কথা কেহই অস্বীকার করিতে পারে না। কিন্তু সেই সুবিধার দ্বারা মনের স্বাভাবিক শক্তিকে একেবারে আচ্ছন্ন করিয়া ফেলিলে বুদ্ধিকে বাবু করিয়া তোলা হয়।

— রবীন্দ্রনাথ ঠাকুর

ভারতের একটা mission আছে, একটা গৌরবময় ভবিষ্যৎ আছে, সেই ভবিষ্যৎ ভারতের উত্তরাধিকারী আমরাই। নূতন ভারতের মুক্তির ইতিহাস আমরাই রচনা করছি এবং করব। এই বিশ্বাস আছে বলেই আমরা সব দুঃখ কষ্ট সহ্য করতে পারি, অন্ধকারময় বর্তমানকে অগ্রাহ্য করতে পারি, বাস্তবের নিষ্ঠুর সত্যগুলি আদর্শের কঠিন আঘাতে ধূলিসাৎ করতে পারি।

— সুভাষচন্দ্র বসু

Any system of education which ignores Indian conditions, requirements, history and sociology is too unscientific to commend itself to any rational support.

— Subhas Chandra Bose

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