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Fundamental of RESEARCH METHODOLOGY and STATISTICS

Yogesh Kumar Singh

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Preface

The education system of India has covered a long distance from gurukul system to British Empire. During this period it has faced so many social problems and it has tried to save their own traditions and social system for the new generation as we are feeling now and observing their qualities to develop our country, as we want. But we should not forget that present tradition system of education has their own qualities due to these qualities and principles it has covered a long distance of his development, now it is a part of the history. Here is a question that if we have our own history of education and research than why we are carrying the British education system and research since independence? It is a very mere question and we have to facing a lot of problems almost in every walk of life to find its answer. An Indian citizen can simply answer that the field of education and research has also been pol1uted with those significant problems, which are carrying by the Indian Education System and research since 1947.

India has got the British system of Education having its own structure and functions in heritage and a concerted effort has been made since, then to utilize that heritage in order to achieve comparable results by democratic means; though we pledged in 1950 on the 26th day of January. We, the people of India having solemnly resolved to constitute into a sovereign democratic republic and to secure to all citizens; justice-social, economic and political liberty of thoughts, of status and opportunity and to promote among them all, fraternity assuring dignity of the individual and the unity of Nation; in our constituent assembly do hereby adopt, exact and give to ourselves this constitution.

Could we fulfill this pledge to this date? The answer is very big no. Neither we could maintain our democratic ideals nor could we achieve justice, fraternity and liberty. Even we failed to unite our nation–mentally, and physically, both. After analyzing the various factors we come to the conclusion that it is all due to our faulty system of education and their wrong objectives directed by the our old educationist. To help our county and society and also to achieve the desired goal of life, we should understand and to create awareness about the research of our social system.

The goal of life is to get good and effective research based education for which we have need good and effective education system. The present volume is a humble effort to present the research problems of social sciences through their past history, as author has perceived.

Almost every social research aspect of social sciences and their problems are covered in this book. The problems can be solved only if there are a large number of idealistic education and research workers devoted to the cause. The author will be highly thankful if you will send your valuable suggestion to up-grade the chapters of this book.

Y.K. Singh

Content

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Chapter 1

Perception of Research

Research has moved during this century from the periphery to the centre of our social and economic life. What is the nature of this force? Why it is getting momentum? Most of us recognize that the progress which has been made in our society has been largely the result of research, we do not have an exact definition of the term. Most of us have a vague idea of what is involved but our concept of research generally is too much oriented toward experimentation as conducted in the social sciences.

MEANING OF RESEARCH

Research simply seeks the answer of certain questions which have not been answered so far and the answers depend upon human efforts. It may be illustrated by taking an example of the moon. Some years ago man did not know what exactly the moon is? Was this problem which had no solution? Man could only make some assumptions about it but the man now this time by his efforts, he went to the moon brought the soil of the moon and studied it. The man is now able to give concrete answer of the problem what is the moon? But the question arises, "Is the answer of the question in examination also research"? The answer is 'no', because the answers of these questions are available. They are available in text-books, class-notes etc. Research answers only those questions of which the answers are not available in literature i.e., in human knowledge. Thus, we can say research seeks the answer only of those questions of which the answers can be given on the basis of available facilities.

Actually research is simply the process of arriving as dependable solution to a problem through the planned and systematic collection, analysis and interpretation of data. Research is the most important process for advancing knowledge for promoting progress and to enable man to relate more effectively to his environment to accomplish his purpose and to resolve his conflicts. Although it is not the only way, it is one of the more effective ways of solving scientific problems.

From the beginning of time man has noted certain irregularities among the phenomena and events of his experiences and has attempted to devise laws and principles which express these regularities. These laws and principles are of course not without expectation, any law is valid only under the conditions under which it was derived. Even though objects tend to fall, they have been known to rise when other forces are active, but this does not deny the general principle of gravity. Research is devoted to find the conditions under which a certain phenomenon occurs and the conditions under which it does not occur in what might appear to be similar circumstances.

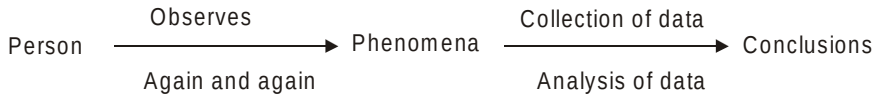
Our culture puts such a premium on science that the terms science and scientific are frequently misused. Research is also frequently in contexts where little research in the true sense of the world is actually done. A person no longer looks up a word in dictionary or a historical fact in the encyclopaedia he researches it. Many agencies claiming to do research are engaged in nothing more than fact-findings.

TERM RESEARCH

The term 'Research' consists of two words:

Research = Re + Search

'Re' means again and again and 'Search' means to find out something, the following is the process:



Therefore, research means to observe the phenomena again and again from different dimensions. For example there are many theories of learning due to the observation from different dimensions.

The research is a process of which a person observes the phenomena again and again and collects the data and on the basis of data he draws some conclusions.

Research is oriented towards the discovery of relationship that exists among phenomena of the world in which we live. The fundamental assumption is that invariant relationship exists between certain antecedents and certain consequents so that under a specific set of conditions a certain consequents can be expected to follow the introduction of a given antecedent.

DEFINITIONS OF RESEARCH

According to Rusk

"Research is a point of view, an attitude of inquiry or a frame of mind. It asks questions which have hitherto not been asked, and it seeks to answer them by following a fairly definite procedure. It is not a mere theorising, but rather an attempt to elicit facts and to face them once they have been assembled. Research is likewise not an attempt to bolster up pre-conceived opinions, and it implies a readiness to accept the conclusions to which an inquiry leads, no matter how unwelcome they may prove. When successful, research adds to the scientific knowledge of the subject.

According to George J. Mouly

He defines research as, "The systematic and scholarly application of the scientific method interpreted in its broader sense, to the solution of social studiesal problems; conversely, any systematic study designed to promote the development of social studies as a science can be considered research."

According to Francis G. Cornell

"To be sure the best research is that which is reliable verifiable and exhaustive, so that it provides information in which we have confidence. The main point here is that research is, literally speaking, a kind of human behaviour, an activity in which people engage. By this definition all intelligent human behaviour involves some research."

"In social studies, teachers, administrators, or others engage in 'Research' when they systematically and purposefully assemble information about schools, school children, the social matrix in which a school or school system is determined, the characteristic of the learner or the interaction between the school and pupil."

According to Clifford Woody of the University of Michigan

He writes that in an article in the Journal of Social Studies Research (1927), research is a carefully inquiry or examination in seeking facts or principles; a diligent investigation to ascertain something, according to Webster's New International Dictionary. This definition makes clear the fact that research is not merely a search for truth, but a prolonged, intensive, purposeful search. In the last analysis, research constitutes a method for the discovery of truth which is really a method of critical thinking. It comprises defining and redefining problems; formulating hypotheses or suggested solutions; collecting, organising and evaluating data; making deductions and reaching conclusions; and at last, carefully testing the conclusions to determine whether they fit the formulating hypotheses.

According to C.C. Crawford

He writes that "Research is simply a systematic and refined technique of thinking, employing specialised tools, instruments, and procedures in order to obtain a more adequate solution of a problem than would be possible under ordinary means. It starts with a problem, collects data or facts, analysis these critically and reaches decisions based on the actual evidence. It evolves original work instead of mere exercise of personal. It evolves from a genuine desire to know rather than a desire to prove something. It is quantitative, seeking to know not only what but how much, and measurement is therefore, a central feature of it."

John W. Best thinks, "Research is considered to be the more formal, systematic, intensive process of carrying on the scientific methods of analysis. It involves a more systematic structure of investigation, usually resulting in some sort of formal record of procedures and a report of results or conclusions."

"Research is but diligent search which enjoys the high flavour or primitive hunting."

– James Harvey Robinson

"Research is the manipulation of things concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in the practice of an art."

– Encyclopaedia of Social Science

"Research is a systematized effort to gain new knowledge."

– V. Redman and A.V.H. Mory

According to C. Francies Rummel

"Research is an endeavour to discover, develop and verify knowledge. It is an intellectual process that has developed over hundreds of years, ever changing in purpose and form and always searching for truth."

P.M. Cook has given a very comprehensive and functional definition of the term research

"Research is an honest exhaustive, intelligent searching for facts and their meanings or implications with reference to a given problem. The product or findings of a given piece of research should be an authentic, verifiable and contribution to knowledge in the field studied."

He has emphasised the following characteristics of research in his definition:

1. It is an honest and exhaustive process.
2. The facts are studied with understanding.
3. The facts are discovered in the light of problem. Research is problem-centred.
4. The findings are valid and verifiable.
5. Research work should contribute new knowledge in that field.

According to W.S. Monroe

Monroe, University of Illinois states, "Research may be defined as a method of studying problems whose solutions are to be derived partly or wholly from facts. The facts dealt with in research may be statements of opinion, historical facts, those contained in records and reports, the results of tests, answers to questionnaires, experimental data of any sort, and so forth. The final purpose of research is to ascertain principles and develop procedures for use in the field of social studies; therefore, it should conclude by formulating principles or procedures. The mere collection and tabulation of facts is not research, though it may be preliminary to it on eve a part thereof."

According to R.M. Hutchins

R.M. Hutchins, Chancellor of the University of Chicago, in "The Higher Learning in America" says, "Research in the sense of the development, elaboration, and refinement of principles, together with the collection and use of empirical materials to aid in these processes, is one of the highest activities of a university and one in which all its professors should be engaged."

J.H. McGrath and D.E. Watson have defined the term 'Research' more comprehensively.

"Research is a process which has utility to the extent that class of inquiry employed as the research activity vehicle is capable of adding knowledge, of stimulating progress and helping society and man relate more efficiently and effectively to the problems that society and man perpetuate and create."

GENERAL CHARACTERISTICS OF RESEARCH

The following characteristics may be gathered from the definitions of 'Research'

1. It gathers new knowledge or data from primary or first-hand sources.
2. It places emphasis upon the discovery of general principles.
3. It is an exact systematic and accurate investigation.
4. It uses certain valid data gathering devices.
5. It is logical and objective.
6. The researcher resists the temptation to seek only the data that support his hypotheses.
7. The researcher eliminates personal feelings and preferences.
8. It endeavours to organise data in quantitative terms.
9. Research is patient and unhurried activity.
10. The researcher is willing to follow his procedures to the conclusions that may be unpopular and bring social disapproval.
11. Research is carefully recorded and reported.
12. Conclusions and generalisations are arrived at carefully and cautiously.

THE FUNCTIONS OF RESEARCH

The following are the main functions of research

The main function of research is to improve research procedures through the refinement and extension of knowledge.

The refinement of existing knowledge or the acquisition of new knowledge is essentially an intermediate step toward the improvement of the social studiesal process.

The social studiesal improvement is associated with various aspects of Social Studies:

(*a*) The function of research is to aid to making a decision concerning the refinement or extension of knowledge in this particular area.

(*b*) The function of research is to improve the students learning and classroom problem with which teacher is encountering with problems. The more effective techniques for teaching can be developed.

(*c*) Another function of research is to aid social studiesal administrators to improve the Social Studiesal systems.

The Researches should contribute to the theory and practice of study studies simultaneously. It should have the image of a helpful mechanism which can be used by researcher/researchsholar in one way or the other, for the improvement of the process.

SPECIFIC CHARACTERISTICS OF RESEARCH

The following are the main characteristics of research:

1. A sound philosophy of social studies as the basis of research

Robert R. Rusk observes. "In the application of scientific procedure to social studies a sound philosophy-as well as a sound commonsense must be invoked to save the scientific procedure from itself."

2. Research is based on insight and imagination

The same writer feels, "Social studies by its reliance on research must never fail to realize that in addition to its practical practitioner and skilled investigators, it stands in need of men and women of imaginative insight, who look beyond, he present and behold the vision splendid. If the vision should fade into the light of common day, not only will the people perish, but research itself will become a sterile futility."

3. Research requires an inter-disciplinary approach

Research is not the mere description of elementary and isolated facts of nature. It must be related to the study of complex relationships of various facts. It requires an inter- disciplinary approach.

4. Research usually employs deductive reasoning process

Eric Hylla writes in the 'Nature and Functions of Research', the science of mind commonly uses methods of description, explanation, interpretation, sympathetic or intuitive understanding methods which are mainly speculative and deductive in character and which rarely furnish results that can be subjected to measurement or mathematical procedures.

5. Research should come out of a desire to do things better

Stephen M. Corey writes. "Better social studiesal means better development or formulation of instructional aims, better motivation of pupils, better teaching methods, better evaluation and better supervision and administration, these are 'activities' or 'operations'.

6. Research is not as exact as research in physical science

No two human beings have ever been found to be alike. No scientific investigations of human behaviour even those of socalled "identical twins" have resulted in the findings of individuals completely similar in structure or behaviour. "In the whole world there are probably no two things exactly alike similarly no two human beings are alike, they differ physically in size, weight, height, colour of eyes and hair texture of skin and in a thousand other details as well as in thousands of details of mental, social and spiritual life," writes H.C. McKown. This fact stands in the way of making research as an exact science.

7. Research is not the field of the specialist only

W.C. Redford writes, "In sum, I believe the teachers in every country have the opportunity and the capacity to undertake some research. Such research, carried out in the day-to-day work of the school, should be concerned directly with the problems of that school. It can properly concern itself with such matters as child development, class organisation, teacher-pupil relationships, interaction with the community, curriculum matters, teaching techniques and many others."

Similarly, V.V. Kamat, in an article entitled "Can a teacher do research?" published in 'Teaching' making these remarks: "Any teacher with commonsense, intelligence and insight can undertake research in a problem. In the beginning such workers may require some guidance and training but this can be made easily available to them at the hands of experts."

8. Research generally requires inexpensive material

In many social studies research studies we simply need subjects, i.e., children, their social studiesal tools of daily use, paper and pencil and a few tests.

9. Research is based on the subjectivity and intangibility of social phenomena

Lundberg has pointed out that the physical phenomena may be known directly through sense, whereas social phenomena are known only symbolically through words representing such phenomena as tradition, custom, attitude, values and the whole realm of so called subjective worlds.

10. Research is perhaps incapable of being dealt through empirical method

According to Lundberg "Exact science tends to become increasingly quantitative in its units, measures, and terminology while most of the matter of social science is quantitative and does not admit of quantitative statement. We can talk of urbanisation, cultural assimilation etc. but we can't measure quantitatively. We may talk of growing indiscipline, but unless we can measure it, unless we can ascertain the degree of indiscipline, we cannot find a perfect cure."

According to Mitchell, "Even in the work of the most statistically minded, qualitative analysis will have a place. Always our measurements, the pre-conceptions shape our ends, our first glimpses of new problems, our widest generalisations will remain qualitative in form."

11. Research is based on inter dependence of causes and effect

In case of a social phenomena the cause and the effect are inter dependent and one stimulates the other. It becomes, therefore, very difficult to find as to what is the cause and what is the fore effect. MacIver rightly points out, "Social science has hitherto suffered greatly from the attempt to make it conform to

method derived from the order and more abstract sciences. It has led us to look for impossible results and to be disappointed at not getting them. We enquire, for example, after the manner of physical sciences which of the two related social phenomena is cause and which the effect. It usually turns out in the social sphere, that both are cause and both are effect.

12. Research cannot be a mechanical process

Symonds concludes that research is, ... "not something that can be ground out as by a machine. Research can never be made a mechanical process. There is no problem worthy of study that does not include unknown elements and does not require a fresh approach and attack. Too much of the research done by students in recent years has smaked of the mechanical or merely following the methods and procedures of some predecessors without clear insight, into the problem itself or the methods to be used in attacking it. Much of the research in social studies that is being published fails to receive recognition because it lacks that spark of originality that must accompany an attack on a new problem. Research methods and techniques can be taught, but after they are mastered there is still the problem of attacking a new problem and genuine contribution to social studies cannot be made without the willingness to pioneer into new fields or to work out new procedures. Genuine research must be an exploration. Any student who wishes to undertake research in social studies must be willing to take venture into the unknown and only by doing so he will bring back the fruit of genuine discovery."

The criticism of research, Hugh B. Wood states: "Every year about a thousand young men and women go off justly neglected corners of knowledge and assemble tiny scraps of more or less useless information into a little pile of dust, which, adopted with comparative tables, correlative graphs, and other forms of academic is served up as a thesis. The reward is the little of Doctor of Philosophy, which enables its recipient to ascend the social studies as ladder and in time teach other young men and women to scrap together their own heaps of dust or doctoral dissertations."

OBJECTIVES OF RESEARCH

The research has the following three objectives:

1. Theoretical objective
2. Factual objective and
3. Application objective.

1. Theoretical Objective

Those researches whose objectives are theoretical formulate the new theories, principles or laws. Such type of research is explanatory because it explains the relationships of certain variables. These researches contribute some basic knowledge to the human knowledge. The researches in different disciplines *i.e.*, Physics, Chemistry, Mathematics etc. have the theoretical objective.

2. Factual Objective

Those researches whose objective is factual find out new facts. This objective is by nature descriptive. These researches describe facts or events which happened previously. Such type of research is done in history.

3. Application Objective

The research having application objective does not contribute a new knowledge in the fund of human knowledge but suggests new applications. By application we mean improvement and modification in practice. For example if anyone gives a new application of electricity then such type of research has application objective.

CLASSIFICATION OF RESEARCH

In actual practice, research is conducted at different levels and for different immediate purposes. The level at which a person operates in the field depends on the objectives he intends to accomplish. Generally research has two levels:

1. Basic level and
2. Applied level.

1. Basic Level

Trevers has defined basic level as basic research. It is designed to add an organized body of scientific knowledge and does not necessarily produce results of immediate practical value.

2. Applied Level

Applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary.

A common mistake is to assume that levels differ according to complexity and that basic research tends to be complex and applied research. Some applied research is quite complex and some basic research is rather simple.

KINDS 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 and
2. Action research.

B. On the Basis of Approach of Research

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

1. **Longitudinal research:** Historical research, case study, genetic comes under longitudinal approach of research.
2. **Cross sectional research:** Experimental research, survey are the examples of cross 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:

1. **Explanatory research:** Such researches explain more concerned theories. laws and principles.
2. **Descriptive research:** These are more concerned with facts.

E. According to National Science Foundation

These National Science Foundation formulated a three-fold classification of research.

1. **Basic research:** Those researches which embrace origin or unique investigation for the advancement of knowledge.
2. **Applied research:** Which may be characterized as the utilization in practice.
3. **Development research:** It is the use of scientific knowledge for the production of useful materials, devices, systems, methods for processes excluding design and production engineering.

F. Another Classification

1. **Adhoc research:** Adhoc research is the class of inquiry used for a purpose alone and special.
2. **Empirical research:** Empirical research is that which depends upon the experience or observation of phenomena and events.
3. **Explained research:** Explained research is that which is based on a theory.
4. **Boarder line research:** Boarder line research is that which involves those main two branches or are as of science. For example study of public school finance.

TYPES OF RESEARCH

There are three types of objectives of research: theoretical, factual and application. The first two types of objectives of research contribute new knowledge in the form of new theory and facts in a particular field of study or discipline.

The third objective does not contribute to knowledge but suggests new application for practical problems. Thus, the researches are classified broadly into two categories:

1. Fundamental or Basic research, and
2. Action research or Applied research.

Meaning and Definition of Action Research

The concept of action research is very old but Stephen M. Corey has applied this concept first in the field of social studies. He has defined the term action research:

"The process by which practitioners attempt to study their problems scientifically in order to guide, correct and evaluate their decision and action is what a number of people have called action research."

According to Corey–"Action research is a process for studying problems by practitioners scientifically to take decision for improving their current practices."

"Research concerned with school problems carried on by school personal to improve schools practice is action research."

– Sara Blackwell.

According Mc. Threte –"Action research is organized, investigative activity, aimed towards to study and constructive change of given endeavour by individual or group concerned with change and improvement."

On the basis of these definitions of action research, the following characteristics may be enumerated :

1. It is a process for studying practical problems of social studies.
2. It is a scientific procedure for finding out a practical solution of current problem.
3. The practitioner can only study his problem.
4. It is a personal research for clinical research work.
5. The focus is to improve and modify the current practices.
6. The individual and group problems studied by action research.
7. It does not contribute to the fund of knowledge.

Origin of Action Research

The concept of action research is based on the 'Modern Human Organization Theory.' This organization theory is task and relationship centred. It assumes that worker of the organization has the capacity to solve the problem and take decision. He brings certain values, interest and attitudes in the organization. Therefore, the opportunities should be given to the workers of the organization to study and solve the current problems of their practices so that they can improve and modify their practices.

The effectiveness of an organization depends on the abilities and skills of the workers. They have to encounter some problems and can realize the gravity of the problems. The practitioner can only study and solve the problems of the current practices. The workers' will be efficient when they will be given freedom for improving and modifying their practices.

The origin of action research is also considered from the field of psychology or social psychology. Kurt Lewin explains life space in terms of person and goal. There is a barrier in between person and goal. He was to overcome the barrier to achieve the goal. 'It depends on the abilities of the person to achieve the goal. The person's activities are governed by the goal. The practitioner has to face this type of situation.

The concept of action research is being used in Social Studies since (1926). Backingham has mentioned this concept first in his book 'Research for Teachers'. But Stephen M. Corey used this concept for solving the problems of Social Studies for the first time.

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 may be 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 for student learning.
8. To raise the level of performance and level of aspiration of the students.

Fields of Action Research

The action research projects may be designed in the following field of Social Studies:

1. In improving and modifying the classroom teaching strategies, tactics and teaching aids.
2. In developing interests; attitudes and values of the students towards their studies.
3. In dealing the classroom problems and school problem relating to discipline and code of conduct.
4. In assigning the home work so that students should take interest in completing them.
5. In improving the spelling errors and wrong pronunciation.
6. In dealing with the problems of poor attendance in class as well as In school and coming late in school.
7. In developing the habit of completing class notes and active participation.
8. In removing the practice of copying in the examination.
9. In solving the personal problems of students relating to school situations or poor adjustment.
10. In dealing with the problems of school administration organization.

Characteristics of an Investigator

A good research worker should possess the following qualities:

1. He should have the full understanding about the functions and activities of his job.
2. He should have the reflective thinking about various dimensions of his job activities.
3. He should be sensitive towards his job. A sensitive person can perceive the problem. Most of the teachers are problem blind because they are not sensitive towards the job.
4. He should be creative and imaginative. These abilities are essential in formulating the action hypotheses for his problem.
5. He should have the knowledge and training of action research. .
6. He should have insightful into his area. During his teaching experience he can identify the real problem on the basis of his insight.
7. He should have the scientific attitude for studying and observing things.
8. There should be an objectivity in his thinking.
9. His behaviour should be democratic. The action research design should not intervene the activities of other teachers of school activities.
10. The most important characteristics is the patience and pursuant of the investigator.
11. He should have knowledge and skill of measuring instruments and elementary statistics.
12. He should have open mind so that he can discuss his problems with his colleagues and experts of the field to have correct picture of the problem.
13. He should have an urge to bring about excellence in job economical performance.
14. He should be economical in designing the project from time, energy and money point of view.

Steps of Action Research

In designing and conducting action-hyper-research project the following steps are followed :

1. Identification of Problem

A teacher should be sensitive towards job activities. The problem is isolated from the broad field. The investigator must realize the seriousness of the problem.

2. Defining and Delimiting the Problem

After Identifying the problem. it should be defined so that action and goal may be specified. The delimitation means to localize the problem in terms of class subject, group and period in which a teacher perceives the problem.

3. Analysing Causes of the Problem

The causes of the problem are analysed with the help of some evidences. The nature of the causes is also analysed whether it is under the control or beyond the control of the investigator. This helps in formulating the action hypothesis.

4. Formulating the Action Hypotheses

The basis for the formulation action-hypotheses are the causes of the problem which are under the approach of the investigator. The statement of action-hypothesis consists of the two aspects: action and goal. It indicates that the action should be taken for achieving the goal.

5. Design for Testing the Action Hypothesis

A design is developed for testing the most important action-hypothesis. Some actions may be taken and their results are observed. If the hypothesis is not accepted second design is developed for testing another hypothesis. In action-research one hypothesis is tested at a time. The design of action-research is flexible and can be changed at any time according to the convenience of the researcher.

6. Conclusions of Action Research Project

The accepting or rejecting the action-hypothesis leads to draw some conclusions. The statement of conclusion indicates some prescription for the practical problem of school or classroom. The conclusions are useful in modifying and improving the current practices of school and classroom teaching.

The National Council of Research and Training has been taken interest in the action research projects. The extension departments of NCERT have been conducting seminars and workshops for in service teachers for imparting knowledge and skill of action research projects. It has developed Its own paradigm of action I research projects.

A Paradigm of Action Research Projects

The steps and sub-steps are proposed by NCERT for conducting action research projects:

1. Topic of the project.
2. Objective of the project.
3. The system of the project work.
4. Evaluation of the project.
5. Estimation of expenditure for the project.
6. Name of the institution, number of students enrolled with sections.
7. Number of teachers in different subjects.
8. The available facilities in school for the project work.
   (*a*) Background for the project work.
   (*b*) The importance of the project for the school.

(*c*) Identification of problem.
(*d*) Defining and delimiting the problem.
(*e*) Formulation of action hypotheses.
(*f*) Testing the action hypotheses.
(*g*) Conclusions of the project work.
(*h*) Remarks by the investigator.

On these lines the teacher plans an experimental project, after conducting the experiment he writes a report of his project work.

Experimental Project of Action Research

The experimental project is designed for solving the problem of English teaching.

1. *Topic of the Project*

A study for improving the spelling errors in English.

2. *Investigator*

An experienced teacher of English.

3. *Background for the Project Work*

The English teacher has observed and experienced that students commit more errors in English spellings. He has noted several types of spelling errors in student's home assignments compositions, translation and their written work.

4. *Objectives of the Project*

This project is designed and conducted for achieving the following objectives:

(*i*) To make sensitive to students for their spelling errors in English.
(*ii*) To improve the English spellings of the students.
(*iii*) To promote the level of achievement in English.
(*iv*) To realize the need and importance of correct spellings in English language.

This project is directly conditioned by these objectives.

5. *The Importance of the Project for the School*

English is the second language but it is the international language.

Even in our country we can exchange the ideas with the persons living in every con mer. It is only the media of communication in our country as well as abroad. It is an important language. Therefore students must learn English correctly.

6. *Field of the Problem*

The field of project is the spelling errors in English language.

7. *Specification of the Problem*

The problem is located in class IX A, period second at DAV Inter College Dehradun. The students of this class commit several types of spelling errors in English.

8. *Analysing Causes of the Problem*

The causes of the problem are identified objectively so that tentative solutions may be developed for the problem. The causes are analysed with the help of following table.

	Causes	*Evidence*	*Nature*	*Control*
1.	The students do not complete their written work attentively and seriously.	By observing the written work of students in English Language.	Fact	Under the approach of the teacher
2.	They do not give due attention to spelling during their study.	By administering recognition or recall types test.	May be fact of Conjecture	Under the approach of the teacher
3.	The teachers do not give due importance to spellings during their teaching.	Inquiring from the students and supervising their written work.	May be or Conjecture	Under the approach of the teacher
4.	The students are lacking in the pre-requisites do not have clear understanding of English grammar.	Oral questions may be asked on English grammar and previous knowledge	Fact	May be or may not be under the approach of teacher.

The analysis of the causes of the problem provides the basis for the formulation of action hypotheses.

9. *Formulation of Action Hypotheses*

The following two action hypotheses have been developed by considering the causes which are under the approach of the English teacher.

First Action Hypothesis: The modification and improvement may be done in English spelling errors by proper correction of English written work.

The first part of Action Hypothesis indicates goal and later part is the action to be taken for achieving the goal.

Second Action Hypothesis: The spellings of words and their meanings should be emphasized by the teacher to improve the spelling errors in English teaching.

The first part of this action hypothesis refers to the action part and second part indicates the goal.

The action hypotheses are tested by using separate designs of the project.

10. *Design for Testing Action Hypothesis*

The first action hypothesis is tested by employing the following design of the project.

The data are collected during the project work if the evidences indicate significant improvement in spellings of English words. There is no need to test the second hypothesis.

11. *Evaluation*

The evaluation of the project work is done in terms of accepting and rejecting the. hypothesis. The bar diagrams are prepared for the spelling errors. The percentages of errors are calculated to analyse the

improvement in English spellings. Some spelling tests may be administered to examine the significance of improvement in english spellings.

The conclusions may be drawn in the form of remedial measures for the problem.

	Initiation of Activities	*Technique*	*Source*	*Time*
1.	The teacher will prepare a list of different types of written work of English.	He will discuss this issue to other English teachers	Text-books and prescribed syllabus.	Two days
2.	The teacher will prepare an outline of his written work of his whole session or semester.	By considering the papers of English which has been assigned to him.	Programme of the whole session and time table.	Three days
3.	The teacher will assign written work I every week of different nature.	The students work load may be considered in assigning the written work.	By consulting the teachers of other subjects regarding home work.	Four weeks
4.	The teacher has to check the written work of English properly and will assign some grades or marks.	The written work may be checked before the students or in their absence.	He can take help of good students of English.	Four weeks

12. *Comments of the Investigator*

After testing the hypothesis teacher may improve the teaching techniques and instructional procedure. The teacher can minimise the English spelling errors. He can promote the level of achievement in English.

Suggestions for Action Research Project

In developing an action research project the following suggestions should be kept in mind:

1. The nature of the project should be decided whether it is developmental project or experimental project.
2. The investigator must be directly associated with the problem to be studied.
3. The form of problem should be real.
4. The project should be so planned that it should not intervene the functioning of other school working.

5. The project should be concerned directly with qualitative improvement and level of performance of the students.
6. The project should be evaluated objectively by employing reliable and valid tools.
7. The action hypothesis should be formulated by considering the causes of the problem which are under the approach of the investigator.
8. The design of action research project should be economical from money, time and energy of view.
9. The problem should be selected objectively and studied scientifically.
10. The causes of the problem should be isolated objectively on the basis of some evidences.

Difference between Action Research and Fundamental Research

The Research has two main functions:

– To contribute new knowledge in Social Studies.

– To improve the Social Studiesal practices.

The first function is of fundamental research and second function of action research. Difference between the two has been given in the tabular form.

Difference between Fundamental Research and Action Research

Action Research	*Fundamental Research*
1. Purpose The improvement in school and classroom teaching process.	Fundamental Research Contributes new knowledge in the form of new theory, facts and truth.
2. Investigator The person is in the job teacher, principal inspector and administrator. Investigator must be directly associated with the problem. There is no pre-requisite of academic qualifications.	The investigator should have postgraduate degree in the subject. He should have specialization in the field. He may or may not be related with the problem.
3. Problem The form of the problem is very narrow. It is a local problem. It is practical problem. The problem is selected and finalized by the worker or investigator himself. No external approval is required.	The problem is broad and relates to the broad field of Social Studies. The problem may be selected by the researcher but it is approved by the external experts.
4. Hypothesis The action hypotheses are formulated on the basis of the causes of the problem. An action hypothesis needs one design of research. One hypothesis is tested at one time.	The hypotheses are formulated on the basis of some retionale. All the hypotheses are tested by one design of research. The hypothesis is not essential in all types of research.
5. Design The design of action research is flexible. It can be changed according to the convenience of the worker. It includes certain steps and measuring tools.	The design is rigid and it can not be changed. Theoretical and practical knowledge is essential for the researcher. It involves method, sample and techniques of research.

Action Research	*Fundamental Research*
6. Sampling There is not problem of sampling in action research, accidental or incidental sample is used. The students of a class or school is the sample of action research. Non-probability techniques is used.	It is the basis of research and sampling is the major problem. The knowledge and training of sampling techniques are essential, usually probability sampling techniques is employed. The true representative sample is selected by using an appropriate technique of sampling from the population.
7. Data Collection Observation and teacher made tests are used for collecting data in action research. The standardized tool may be used if it is available.	Usually the standardized tests are used for collecting data in basic research. If the tools of such types are not available the investigator has to prepare the tools and its reliability and validity are estimated.
8. Analysis of Data The data are analysed by using statistical technique to draw some results. Simple statistics: percentages mean mode, S.D. and graphical representation are employed for this purpose. The decision is taken about solution of the problem.	The parametric statistical techniques are used for analysing the data. The knowledge and understanding are essential. The decision is taken about the hypotheses on the basis of data or evidences.
9. Conclusions Some conclusions are drawn about the solution of the problem. The conclusions are in the form of remedial measures for improving the current practices. It does not contribute to the fund of knowledge.	The conclusions are in the form of generalization. The generalization may be a new theory or new fact or new truth or new interpretation. Thus, the conclusions may be the new knowledge in the field studied.
10. Evaluation The action research project is evaluated by the investigator himself and no external evaluation is required. Its results are in the form of improvement in the job and current practices.	A panel of examiners is appointed for examining the report of fundamental research. It may be approved, or revised or rejected. The degree of Ph.D., D.Sc. or D.Phil. is awarded for the worth contribution in the field studied.
11. Finances The finances for the action research are met out by the school or investigator himself. The extension deptt. of NCERT are also financing such projects.	The U.G.C. is awarding Junior research fellow and senior research fellowships for fundamental research in all the, subjects. The NCERT is financing research projects of Social Studies. The U.G.C. is also giving financial, assistance to college teachers for their research work. An investigator also bears the expenses himself.
12. Training The teachers are trained in B.Ed. and L.T. programmes for the knowledge and skill of action research concept. The extension departments are organizing workshops for action research projects for in-service teachers.	There is a compulsory paper of Research Methods and Statistics of M.Ed., M.B.A. and M.Phil. levels for the knowledge and understanding of research methodology. During this programme the students have to submit a dissertation for the practical knowledge of conducting research work.

Action Research	*Fundamental Research*
12. Training The teachers are trained in B.Ed. and L.T. programmes for the knowledge and skill of action research concept. The extension departments are organizing workshops for action research projects for in-service teachers.	There is a compulsory paper of Research Methods and Statistics of M.Ed. and M.Phil. levels for the knowledge and understanding of research methodology. During this programme the students have to submit a dissertation for the practical knowledge of conducting research work.
13. Scope The field of action research work is very narrow. It deals with the problems of classroom teaching and school. The field is local.	The field for basic research is broad. It deals with the basic problems of Social Studies and teaching learning situations.
14. Examples The problem of assignment, spellings, pronunciation and poor attendance. The enrolment of school is reducing rapidly are the major problems of action research in the field of Social Studies.	(*a*) Teaching skills for different subject teachers (languages, social studies science). (*b*) Behaviour patterns or effective teachers and creative teachers. (*c*) Difference between trained and untrained teachers performances.
15. Importance The major importance for solving the local problems of school and classroom teaching.	The major importance is to answer the basic questions and contribution to the field of knowledge by solving the basic problems of Social Studies.

Exercises

1. Define the term 'Research', Enumerate the characteristics of research. Give a comprehensive definition of research.
2. Define the term 'Research'. Describe the specific features of Research,
3. Enumerate the main objectives of research and explain them in detail.
4. Describe the various classification of research, Differentiate between fundamental research and action research. Elaborate your answer with examples.
5. Describe the steps of research. Enumerate the objectives of action research.
6. Plan an action research project and describe the various steps which are followed in completing the project.

Chapter 2

Assortment of Problem

Research is not only to develop the process or to find a formula as we do in the science.But in the field of social science the research work is oriented towards the solution of a problem or to seek an answer of a question. The first step of a research process is to identify a problem. The selection of a problem is governed by reflective thinking. Unthinking activity is governed too completely by tradition or by emotion. Primitive life was largely without effective reflective thought, until some intelligent individual conceived of a new solution for an old problem. Therefore. upper educational groups ever do much careful ordered thinking. The normal human mind thinking may be classified into four categories: convergent, divergent reflective and scientific thinking. In reflective thinking individual conceived for a new solution for an old problem, but scientific thinking is in terms of carefully organized reflection.

REFLECTIVE THINKING

The reflective thinking implies two components: mastery of the situation or content plus divergent thinking or creative thinking. The reflective thinking acts in terms of problem situation, therefore, it involves the following steps:

1. The occurrence of a felt need or difficult.
2. Definition of the problem in terms of a problem statement.
3. Occurrence of a suggested explanation or possible solution or hypothesis or tentative theory.
4. The rationale elaboration of an idea through the development of its implication by means of collection of data or evidences.
5. Collection of the ideas and formation of concluding belief through experimental verification of the hypothesis.
6. Conclusions and formulation of generalizations. It is recognized that at every level of generalization the human mind may act through these steps. The research process involves inductive-deductive mode of thinking which is known as scientific thinking.

SCIENTIFIC THINKING

The scientific thinking is defined as an inductive-deductive mode of thinking or reasoning in which one seeks to explain the uniformities of nature by appealing to experiences.

- Induction moves forward from particular to the general.
- Deduction is backward movement from general to particular.

The scientific thinking starts with facts and continually returns to facts to test and verify its hypotheses. It is based on empirical evidences and establishes cause and effect relationship. The sources of evidences are based on the following methods: customs and traditions, authority, personal experiences, syllogistic reasoning, self-evident proposition and scientific inquiry and experimentation. These methods

of seeking truth have continued to the present day and form man's current intellectual equipment for solving problem of life. Man in his quest for truth has appealed in general to five sources, of evidences.

1. Custom and Tradition

The majority of man's opinions, attitude and actions will be as they are, because he knows, desires or has time to discover nothing better. The customs of his times and traditions of his people will decide such things for him. His clothes, speech, food and mode of living are largely determined in the same manner. There is necessary human economy but the fact that a thing is, or has always been so is employed as its justification. The result may be an appealing intellectual stagnation. When man recognized his own mental inadequacies in this respect, a great step forward was taken in the development of human thinking.

2. Authority

Average man with his belief in magic charms and the supernatural appealed to the tribal wise man and gods in times of crises. These practices have been superseded by secular and religious authorities in civilized nations.

Aim, content, methodology of education was determined by the authority of religion or nation. With the growth of strong secular states, the balance of power passed from religion to states, and the appeal was addressed to kings parliaments and legislatures.

Other sources of authority are found in nations, Scholars, philosophers and scientists.

3. Personal Experience

When confronted with a difficult situation. one naturally turns first to his own experiences in similar situation for the idea of what to do. If his own experiences are inadequate, he may turn to those of friends and acquaintances. History offers the means by which the experiences of people are extended from the remote time and places to the present. It is subjected to gross inaccuracies. The following are the important sources of errors:

(*a*) Argument from a single or limited number of instances.
(*b*) Argument from positive instances and neglect of negative instances.
(*c*) Avoidance of evidence contrary to one's opinion.
(*d*) Failure to observe important circumstances affecting to different phenomena.
(*e*) Erroneous conclusions due to preconceived ideas and prejudices.
(*f*) Inaccurate instruments of measurement, dependence upon subjective judgement, estimates and gross.
(*g*) Argument from analogy.

4. Syllogistic Reasoning

From apparently self-evident propositions. A great advance was made when man began to think about his own thinking. The product of early intellectual efforts was deductive logic founded by Aristotle. The Chief instrument of deduction was the syllogism, composed of a major premise, a minor premise and a conclusion e.g.

All sinners deserve punishment
'A' is a sinner

∴ A also deserves punishment.

The essence of such syllogistic reasoning consists chiefly in showing that a given particular case falls under general rule. This method purported to furnish good mental training.

SOME DISTINGUISHING CHARACTERISTICS OF SCIENTIFIC THINKING

There are six main features of scientific thinking:

1. Scientific thinking is based upon cause-effect relationship and evidences.
2. It involves certain principles and certain assumptions.
3. Every scientific thinking employs hypotheses to verify the concepts.
4. It is free from emotional bias, personal prejudices and it is highly objective.
5. It utilizes accurate measurement and observation to contribute in situation.
6. Scientific thinking employs quantitative analysis in the treatment of data for drawing conclusions.

STEPS IN THE PROCESS OF SCIENTIFIC THINKING

The logically related, the following steps are involved in scientific thinking:

1. The location and definition of a problem.
2. The survey of past experiences with problem of previous investigations that are already available.
3. The formulation of hypotheses representing a tentative solution of the problem. All the activities are organized for the verification of the hypotheses (collection of data statistical techniques etc.).
4. The collection of new data or evidences.
5. The analysis of the data classification and summarization by quantitative treatment.
6. The formulation of generalizations.

CHARACTERISTICS OF A GOOD RESEARCHER

In selecting a problem, it is very essential for an investigator to possess the following characteristics:

1. He should be sensitive in his nature.
2. He should be problem-minded.
3. He should have mastery on the area and should have specialization in the field studied.
4. He should have a scientific outlook about the area.
5. He should have deep insight into the educational process.
6. He should be able to think reflectively on the field studied.
7. He should have tolerance and patience.
8. He should be interested in the field studied.
9. He should be honest and devotee to his work.
10. He should have the curiosity to find out something new or to answer some questions which are still to be answered.

IDENTIFICATION OF A PROBLEM

The identification and analysing a research problem is the first and most crucial step of research process. A problem can not be solved effectively unless a researcher possesses the intellect and insight to isolate and understand the specific factors giving rise to the difficulty.

The present research scholars understand that identification of a problem means to select a topic of a research or statement of the problem. It is wrong to think so. A topic or statement of the problem and research problem are not the synonymous but they are inclusive. The problem concerns with the functioning of the broader area of field studied whereas a topic or title or statement of the problem is the verbal statement of the problem. The topic is the definition of the problem which delimits or pin points the task of a researcher.

It is the usual practice of the researches that they select the topic of the study from different sources especially from research abstracts. They do not identify the problem, but a problem is made on the basis of the topic. It results that the researcher has no involvement in his research activities. Whatever they do, do mechanically.

Since identifying the exact nature and dimensions of a problem is of major importance in research work, it is very essential that an investigator should learn how to recognize and define a problem. He should proceed step by step in locating the research problem. The following steps are to be followed in identifying a research problem:

Step 1 : Determining the field of research in which a researcher is keen to do the research work.

Step 2 : The researcher should develop the mastery on the area or it should be the field of his specialization.

Step 3 : He should review the researches conducted in area to know the recent trend and studies in the area.

Step 4: On the basis of review, he should consider the priority field of the study.

Step 5: He should draw an analogy and insight in identifying a problem or employ his personal experience of the field in locating the problem. He may take help of supervisor or expertee of the field.

Step 6 : He should pin-point specific aspect of the problem which is to be investigated.

For example a researcher wants to work in the field of teacher-education which is the field of his interest. He has the deep insight and mastery over the area. On the basis of review and his personal experience, the researcher perceives a problem in the field of teacher-education programme that training institutions and colleges of education are not able to produce effective teachers although large number of such institutions have been opened after independence. This problem has the several dimensions but these can be studied simultaneously. The researcher further visualizes that the potential candidates are not admitted in this programme. A question arises: Are the potential candidates admitted in our teacher-education problem? Thus, the procedure of identification of a problem can be shown with the help of a paradigm.

The following are the major tasks to be performed in analysing a problematic situation as given below:

1. Accumulating the facts that might be related to the problem.
2. Setting by observations whether the facts are relevant.
3. Tracing any relationship between facts that might reveal the key to the difficulty.
4. Proposing various explanations for the cause or the difficulty.

5. Ascertaining through observations and analysis whether these explanations are relevant to the problem.
6. Tracing relationship between explanations that may give an insight into the problem solution.
7. Tracing relationship between facts and explanations.
8. Questioning assumptions underlying the analysis of the problem.
9. Tracing the irrelevant facts which are not concerned with the problem.
10. Locating the irrelevant explanations which are not related to the problem.

After going through these processes, the researcher will be able to define or state the problem.

SOURCES OF PROBLEMS

The selection of a suitable problem is not an easy task. It is a serious responsibility to commit oneself to a problem that will inevitably require much time and energy and which is so academically significant. The following are the main sources to which one may proceed for a suitable research problem:

1. Personal experiences of the investigator in the field of education are the main source for identifying suitable problem. Many of the problems confronted in the classroom, the school or the community lend themselves to investigation and they are perhaps more appropriate for the beginning researcher than are problems more remote from his own teaching experiences.
2. The other source of problem which is most frequently used by the investigator as suggested by the supervisors, is the extensive study of available literature-research abstracts, journals, hand-books of research international abstracts etc. He can draw an analogy for selecting a research problem or can think parallel problem in the field studied.
3. In the choice of a suitable problem, the researcher has to decide his field of investigation. He should study the field intensively in the specific area, this may enable him to identify a problem from the specific field.
4. The new innovations, technological changes and curricular developments are constantly bringing new problems and new-opportunities for Social Studies Research.
5. The most practical source of problem is to consult supervisor, experts of the field and most experienced person of the field. They may suggest most significant problem of the area. He can discuss certain issues of the area to emerge a problem.
6. It is a general practice that researchers suggest some problems in their research reports. The researcher can pick up a suitable problem for his own study.

CRITERIA FOR SELECTION OF THE PROBLEM

The factors are to be considered in the selection of a research problem both the criteria external and personal. External criteria have to do with such matters as novelty and importance for the field availability of data and method, and institutional or administrative cooperation. Personal criteria involved such considerations as interest, training, cost and time, etc.

Thus criteria for the selection of the problem suggested by Good and Scates are as follows:

1. Novelty and avoidance of unnecessary duplications.
2. Importance for the field represented and implementation.

3. Interest, intellectual curiosity, and drive.
4. Training and personal qualifications.
5. Availability of data and method.
6. Special equipment and working conditions.
7. Approachability of the sample.
8. Sponsorship and administrative cooperation.
9. Hazards, penalties and handicaps.
10. Cost and returns.
11. Time factor.

1. Novelty and avoidance of unnecessary duplication

The question of novelty or newness is not merely one of duplication of earlier investigations. It involves the regency of the data summarized especially in the case of survey studies made during a period of great Economic, Educational and Social change.

2. Importance for the field represented and implementation

This criterion of importance in choice of a problem involves such matters as significance for the field involved, timelines and practical value in term of application and implementation of the results.

Scientific research in Education, psychology and social sciences in general have an especially urgent obligation to play a social role rendering service to society and humanity.

3. Interest, intellectual curiosity and drive

One of the personal motives of research most frequently mentioned by scientists themselves is pure curiosity, accompanied by genuine interest and a drived satisfaction and enjoyment.

4. Availability of data and method

The data under consideration must meet certain standards of accuracy, objectivity and verifiability.

5. Special equipment and working conditions

The major purpose of equipment is to define the process of observation-to provide control of conditions and accuracy or permanence of recording.

6. Sponsorship and administrative cooperation

It is a common practice for the thesis to be sponsored by a faculty adviser in whose area of specialization the problem lies.

7. Costs and returns

The candidate must consider carefully his own financial resources in the light of such facilities and assistance as can be provided by the institution.

8. Time factor

As a general rule the minimum amount of graduate work for the Master's degree is one year, and for the Doctor's degree three years.

Historical, experimental case and longitudinal genetic studies frequently require more time than the several types of normative survey work.

Hildreth Hoke McAshan has proposed an objective guide for judging the merits of a problem. The following questions may be raised for this purpose.

1. Is the problem really important?
2. Is the problem interesting to others?
3. Is the chosen problem a real problem?
4. Does the problem display originality and creativeness?
5. Am I really concerned with finding the solution?
6. Am I able to state hypotheses from the problem in a testable form?
7. Will I learn something new from this problem?
8. Do I understand the relationship of this specific problem to the broader problem area?
9. Will be able to select a sample from which I can generalize to some population?
10. Will some other intelligent person be able to replicate the study?
11. Will my proposed data-gathering instruments actually give the Information which I want?
12. Is the study, including the application of its results, practical? The number of affirmative answers should be required for a suitable problem.

DEFINING A PROBLEM

Defining a problem means "To pin-point the problem or defining a problem to reach the core of the problem i.e. threadbare analysis."

(*a*) Need of defining a problem

The definition of a problem serves the following purposes:

1. The definition of a problem sets the direction of the study.
2. The definition reveals the methodology or procedure of the study.
3. The definition helps the researcher to control subjectivity or biases of the researcher.
4. The definition of the problem suggests and specifies the variables to be taken up into the investigation through a problem involved into so many variables.
5. The-definition makes the research work practicable.

(*b*) Precautions are to be taken in identifying the problem

The following precautions should be taken into consideration for identifying problem.

1. The words used for defining a problem should have a single meaning.
2. The statement of the problem must be brief but comprehensive.
3. The assumptions are to be recognised for the study.
4. The problem should have practical importance in the field of Education.
5. The definition or the statement of the problem should have certain rationale.

(*c*) Steps in defining a problem

The following steps are to be followed in defining a problem:

1. Researcher should have to develop a conceptual framework of the problem. The conceptual framework should be such that it can be stated into verbal form.
2. Delimiting the elements of the problem.
3. Classifying the elements in the homogeneous group.
4. Locating the key-points in the conceptual framework.
5. Evaluating the theoretical security of the problem.
6. The final form of the statement can be given into verbal form to a conceptual framework of the problem.
7. Deciding the practical difficulty in conducting the study.

1. *Analysis of the Problem into its Elements*

The major problem is subdivided into subordinate questions or problems. The definition of the problem is really the planning of the investigation with an indication of the data and techniques needed to answer. The questions raised. The Schematic Analysis of a problem has been shown in Fig. 1.

Schematic Analysis of a Problem

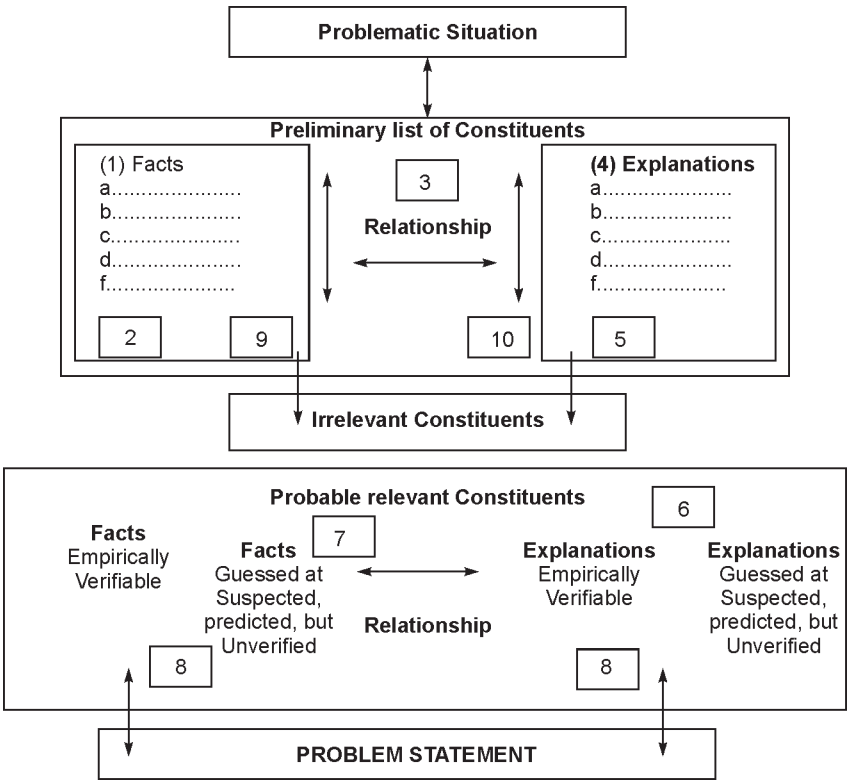


Fig. 1.

2. *Orientation and Related Literature*

Avoidance of unnecessary duplication in the selection of the problems suggest library procedures that should provide the setting for the investigation under consideration and an over view of the related studies. Detailed information concerning use of the appropriate library guides and illustrative review of

the literature in Mrticular area given in fourth chapter. Even though it may rot be feasible in Some report of research to devote a section or chapter of earlier investigations in the same field: The worker himself is obligated to make critical examination of such related studies. Literature may come hypotheses, suggestive methods of research and comparative data useful in the interpretation of results.

Source of Data and Methods

For adequate definition of the problem sources of data and methods for securing evidences must be carefully selected and clearly outlined in the introductory section of the report. Therefore as a matter of intellectual honesty and for accuracy of interpretation and reporting any limitation in sources and procedure must be pointed out frankly but no apologetically.

Terminology

Technical terms and words or phrases with special meaning should be defined.

Initial Assumptions

Research like geometry begins with certain basic assumptions or postulates. Assumptions underlie each step of research. They should be stated not only in the definition of the problem and procedure, but also with the conclusions of which they are an integral part.

(*d*) Ways to Define the Problem

The following are various ways of defining a problem:

1. Analyse the major problems or problems in terms of subordinate problems.
2. Statement delimits the scope of the study.
3. Orientation of the problem in an unique direction:
   (*a*) A historical account, remote or recent.
   (*b*) A survey of previous study or related studies.
   (*c*) An analysis of previous studies or related subjects.
   (*d*) Preliminary survey.
4. Description of the general nature of the problem.
   (*a*) Type.
   (*b*) Source.
   (*c*) procedure.
5. Statement of limitations of the technique employed.
6. Recognitions of assumptions and Implications.
7. Importance-value or significance of the study of education.
8. Definition of terms.

STATEMENT OF PROBLEM

After selecting a problem, it should be stated carefully the researchers to delimit his task and isolate a specific problem before he can proceed with active planning of the study. This type of decision is culminated in the problem statement.

Kerlinger has identified three criteria of good Problem Statements.

1. A problem should be concerned with relation between two or more variables.
2. It should be stated “clearly and unambiguously in question form.”

3. It should be amenable to empirical testing.

Meeting these criteria in his problem statement will result, on the researcher's part, in a clear and concise idea of what he wants to do, this sets the stage for further planning.

CHARACTERISTICS OF A PROBLEM

Although selecting a research problem is one of the most difficult step for a student in a research process, it is unfortunately one for which the least guidance can be given.

A problem statement must have the following characteristics:

1. It should ask about a relationship between two or more variables.
2. It should be stated clearly and unambiguously, usually in question form.
3. It should be possible to collect data or answer the questions asked.
4. It should not represent a moral or ethical position.

1. Relationship between Variables

In this kind of problem the researcher manipulates a minimum of one variable to determine its effects on other variables, as opposed to a purely descriptive study in which the researcher observes, counts or in some way measure the frequency of appearance of a particular variable in a particular setting. For example how many students in school have I.Q.'s in excess of 120.

Since no attempts need be made to deal with a relationship between variables, this problem requires only a "book-keeping" procedure, if however, the problem were worded; Are boys more likely than girls to have 1.0.'s in excess of 120 then it would involve the relationship between variables?

2. The Problem is Stated in Question Form

The problem should be in question form as:

1. What is the relationship between 1.0. and achievement?
2. Do students learn more from a directive teacher or a non directive teacher?
3. Is there a relationship between racial background and dropout rate?
4. Do more students continue in training programmes offering stipends or in programmes not offering stipends?
5. What is the relationship between role learning ability and socio-economic status?

3. Empirical Testability

A problem should be testable by empirical methods, that is, through the collection of data. Moreover, for a student's purposes, it should lend itself to study by a single researcher, on a limited budget, within a year. The nature of the variables included in the problem is a good clue to its testability. An example of the kind of problem that is wise to avoid it: Does an extended experience in communal living improve a person's outlook on life? In addition to the magnitude and probable duration of studying such a problem, the variable themselves would be difficult to manipulate or measure.

4. Avoidance of Moral or Ethical Judgements

Questions about ideals or values are often more difficult to study than questions about aptitudes or performance, as, that would be difficult to test are: Should men define their feelings? The ethical consideration should also be taken into consideration in defining or stating a problem.

CLARIFYING AND STATING A PROBLEM

It is essential for a researcher before he proceeds with his study that he converts his tentative topic into a precise researchable problem. Since a problem is broad infinite therefore it is wise for the researcher to delimit or to narrow the range of the problem in terms of his interests and skill. The problem mentioned in this chapter can be stated in the following way:

Problem: "Analysing the potentials of teacher-effectiveness." This statement is still vague and does not provide any direction to the researcher. It may be restated to clarify the study.

Restatement: "A study of relationship between predictors and criteria of teacher-effectiveness."

This statement indicates the specific task to be performed by the researcher that he has to study the relationship between predictors as independent variables and criteria 'as the dependent variables.

Problem: "The relation of socio-economic status to creativity." It is also vague statement of a problem. It can be clarified and restated in the following way:

Restatement: "A comparative study of the performance of student of different socio-economic status on the items of the Baquer Mehdl creativity test.

Areas of the Research: Educational philosophy, Sociology, Educational Curriculum development, Institutional material, Learning process, Teaching methods, Teacher-education, Teachers behaviour, Educational administration and supervision, Educational technology, etc.

DELIMITING A PROBLEM

Delimiting a problem is very important. A study should be delimited by the following aspects:

1. A study should be delimited to certain variables that should be mentioned clearly in the problem.
2. The study is delimited to the area or level as primary level, secondary level, college or university level.
3. Again study is delimited to size of sample. Considering the time, energy and money, but it should be a representative.
4. Method of Research: A Problem or study may be conducted by different methods but it is not possible. Therefore, the best method should be used so that the study should be delimited to the method only.
5. *Measuring Instrument*: In behavioural science number of instruments are available but all tools can not be used to measure Thus the best available tool will be used for measuring the variable.
6. *Techniques of Research*: A number of techniques can be used for analysing data but most appropriate techniques should be used.
7. The other limitation should vary from problem to problem as every problem has its own delimitations.

These delimitations may help the researcher for conducting the study and the findings of studies also confine to these delimitations.

ASSUMPTIONS ABOUT THE PROBLEM

A good statement of a problem is based on some assumptions. An assumption is the supposition that it is taken for granted to better establish the scope, frame of reference and conditions under which the study will be conducted. The following are the major purposes of assumptions:

1. It makes the research work feasible.
2. It delimits the scope of the problem.
3. It establishes the proper frame of reference.
4. It sets forth certain conditions of the study.
5. It aids in the development of testable hypotheses.
6. It helps in establishing the population and extent of generalization.
7. It also determines the statistical limits for accepting and rejecting of hypotheses.

The assumptions are essential features in the building of scientific model which helps in critical analysis:

EVALUATING THE PROBLEM

1. Before the proposed research problem can be considered appropriate, several searching questions should be rasied. Only when those questions are answered in the affirmative can the problem that can be effectively solved through the process of research. Do the data exist upon which a solution may be based ?
2. Is the problem significant? Is an important principle involved ? Would the solution make any difference as far as educational hero and practice are concerned? If not, there are undoubtedly more significant problems waiting to be investigated.
3. Is the problem a new one? Is the answer already available? Ignorance of prior studies may lead a student to need spend less time on a problem already investigated by some other worker.

   While novelty or originality is an important consideration, the fact that a problem has been investigated in the past does not mean that it is no longer worthy for study. Previous investigations might be using newer and better devices and procedures, but there is also a need for the testing of former findings under changed cultural conditions.
4. Is the problem feasible? After a researcher's project has been evaluated, there remains the problem of suitability for a particular researcher. While the problem may be a good one, as may be a good problem for me. The question arises, will I be able to carry it through to a successful conclusion? Some of the questions that should be raised are:
   (*a*) Do I have the necessary competence to plan and carry out a study of this type? Do I know enough about this field to understand its significant aspects and to interpret my findings? Am I skilful enough to develop administer, and interpret the necessary data-gathering devices' and procedures? Am I well grounded in the necessary knowledge of statistical techniques?
   (*b*) Are pertinent data accessible? Are valid and reliable data gathering devices and procedures available ? Will school authorities permit me to contact the students to conduct necessary experiments or administer necessary tests, interview teachers or have access to important cumulative records? Will I be able to get the sponsorship necessary to open doors that otherwise would be closed to me ?
   (*c*) Will I have the necessary financial resources to carry on this study? What will be the expense involved in data-gathering equipment, printing, test, materials, travel and clerical help? If the project is an expensive one, what is the possibility of getting a grant from a philanthropic foundations or agency?

(*d*) Will I have enough time to complete the project? Will there be time to devise the procedures, select the data gathering devices, gather and analyse the data, and complete the research report? Since most academic programmes impose time limitations, certain worthwhile projects of a longitudinal type are precluded.

(*e*) Will I have the courage and determination to pursue the study inspite of the difficulties and social hazards that may be involved ? Will I be willing to work aggressively when data are difficult to gather and when others are reluctant to co-operate? Will I be willing to risk the criticism, suspicion, or even opposition that a delicate or controversial study may raise? Sex education, racial integration, communism, and other controversial problems are almost certain to stir up emotional reactions in certain quarters.

THE RESEARCH PROPOSAL OR SYNOPSIS

A research proposal or research synopsis or an outline of proposed works required by many universities and institutions, serves as a useful basis for the evaluation of a project as well as a guide line for the researcher. The synopsis contains a clear and concise statement of the problem, the hypothesis involved, a recognition of the significance of the problem, definitions of the important terms, assumptions and limitations, a resume of related literature, an analysis of proposed research producers, and a time schedule. This proposal or synopsis is placed before the research degree committee to examine its worth. The final approval is given by this committee at university level. It is like a blue print of research project.

The preparation of a research proposal or synopsis is an important step in the research process. A worthwhile research work is likely to result only from a well-prepared and well-designed proposal or research synopsis. A research proposal includes. the following essential parts:

1. The Problem and statement of the problem.
2. The Review of literature or theoretical framework of the study.
3. The Hypotheses and objectives.
4. The Methodology and procedure of the study.
5. Educational implications or significance of the problem.
6. Definitions, assumptions and delimitations.
7. A tentative structure of the report.
8. Bibliography.

1. The Statement of the Problem

This attempt to focus on a stated goal gives direction to the research process. It must be limited enough in scope to make a definite conclusion possible. A problem suggests a specific answer or conclusion. The statement of the problem should be written in specific clear-cut words.

2. The Review of Related Literature

A brief summary of previous research should be given so that the researcher and reader may be familiar with what is already known and with what is still unknown and untested. The effective research is based upon past knowledge, this step helps to eliminate replication of what has been done and provides useful basis for the formulation of hypotheses and deciding the methodology of the study. A review of related literature should conclude with a comment of area of agreement and disagreement in findings.

3. The Hypotheses

A scientific study is based on hypotheses. It may be appropriate here to formulate a major hypotheses and several hypotheses. This approach clearly establishes the nature of the problem and the logic underlying the investigation. The hypothesis indicates the expected outcomes the investigation. The formulation of the hypotheses in advance of the data- gathering process is necessary for an unbiased investigation. The hypotheses should be first stated in positive or substantive form.

In every investigation hypotheses can not be formulated but objectives of the study can be written to indicate the direction of the research work.

4. Methodology and Procedure of the Study

This part of the proposal outlines the entire research plan. Under this part of the synopsis method, sample, population, tools and statistical analysis techniques are described in view of testing the formulated hypotheses. It describes just what must be done, how it will be done, what data will be needed, what data-gathering devices will be employed, how sources of data will be selected, and how the data will be analysed and conclusions be drawn.

5. Educational Implication or the Significance of the Problem

It is important part of research synopsis in which research points out the answer to the question or the solution to the problem may influence educational theory or practice. The implication of the finding of the study helps to give the project an urgency, justifying its worth. Social Studies Research study must have its implication to educational practices.

6. Definitions, Assumptions and Limitations

The statement of the problem or topic of the study includes some terms. These terms or variables should be defined clearly. At this stage operational definitions of terms are usually given in research proposal so that statement of the problem must convey the specific meaning. The variables of the study should be defined clearly and unambiguously in operational terms.

A study involves several variables which play different roles in the investigation. The role of the variable depends on the assumptions of the study. The sample of the study will be representative of the population. The assumptions of the study vary study to study.

The feasibility of an investigation depends on the delimitations of the study. A study is delimited to its variables, sample, method, tools and statistical techniques of the study. These delimitations should be clearly mentioned in the synopsis of the study.

7. Structure of the Report

A tentative structure of the report is also written. It includes the list of chapters which will be included in the report of the thesis. These may be: Introductory or a theoretical framework. Review of literature, Methodology and procedure of the study. Data collection and Analysis of data, conclusions of the study.

8. Bibliography

The last part of the proposal provides the list of references in the form of bibliography which includes books of research, or conceptual framework, hand-books encyclopaedia, journals and unpublished and published thesis on the related area of the study.

A proposal of research or synopsis is usually written in third person i.e. he or she or investigator, and in present or future tense. It is submitted to research degree committee's approval. This committee approves as it is or suggests some modifications or rejects the proposal. The researcher can begin only after the approval of the proposal by the committee.

CRITERIA FOR EVALUATING PROPOSAL OR SYNOPSIS

Various agencies establish their own criteria for evaluating proposal of research project. The following are the some criteria which are commonly used for this purpose:

1. Significance of the proposed research for Indian education, including:
   (*a*) Importance of the problem area from the standpoint of basic knowledge of problems of Indian education.
   (*b*) Likely magnitude of the addition that will be made to knowledge if the project is successful, including the generalizability of the results.
2. Quality of the proposed research project, including such considerations as :
   (*a*) Extent to which the application exhibits through knowledge of pertinent previous work and relates the proposed research to it.
   (*b*) Likelihood of success of the project.
   (*c*) Adequacy of design, methodology and tools, where appropriate.
3. Qualifications of the investigator and professional personnel as evidenced by :
   (*a*) Experiences and previous research productivity.
   (*b*) Quality of the discussion and analysis in the application.
4. Adequacy of the facilities and arrangements available to the investigator to conduct the proposed study.
5. Reasonableness of the budget for the work to be done and the anticipated results. These criteria should be incorporated in preparing a research proposal.

EXERCISES

1. Research work is guided by reflective thinking, not by traditional or conventional thinking. Comment on this statement.
2. Indicate the sources of research process. Enumerate the steps of the research process.
3. Give the sources of research problem. How a problem is identified? Enumerate the criteria for the selection of a problem.
4. Why is it necessary to define a problem and delimiting a problem?
5. How is a problem stated? Describe the various ways of defining a problem.
6. Discuss characteristics of good problem and criteria for evaluating a problem.
7. What do you understand by the Research proposal? Give the structure of Research proposal. Enumerate the criteria for evaluating the Research proposal.

Chapter 3

Appraise of Related Literature

Nature has made only one thing that is more powerful in the universe and that is called as Human or Man. Man is the only animal that can take advantage of knowledge which has been preserved or accumulated through the centuries or since the origin of man. Human knowledge has the three phases: preservation, transmission and advancement. This fact is of particular importance in research which operates as a continuous function of ever-closer approximation to the truth. Practically all human knowledge can be found in books and libraries and money in the banks. Unlike other animals that must start a new with each generation, man builds upon the accumulated and recorded knowledge of the past. His constant adding to the vast store of knowledge makes possible progress in all areas of human endeavour. The investigator can ensure that his problem vacuum and that considerable work has already been done on topics which are directly related to his proposed investigation.

For any specific research project to occupy this place in the development of a discipline, the researcher must be thoroughly familiar with both previous theory and research. To assure this familiarity, every research project in the behavioural sciences, has as one of its early stage, a review of the theoretical and research literature.

MEANING OF REVIEW OF LITERATURE

The phrase 'review of literature' consists of two words: Review and Literature. The word 'literature' has conveyed different meaning from the traditional meaning. It is used with reference to the languages e.g. Hindi literature, English literature, Sanskrit literature. It includes a subject content: prose, poetry, dramas, novels, stories etc. Here in research methodology the term literature refers to the knowledge of a particular area of investigation of any discipline which includes theoretical, practical and its research studies.

The term 'review' means to organize the knowledge of the specific area of research to evolve an edifice of knowledge to show that his study would be an addition to this field. The task of review of literature is highly creative and tedious because researcher has to synthesize the available knowledge of the field in a unique way to provide the rationale for his study.

The very words 'review' and 'literature' have quite different meanings in the historical approach. In historical research, the researcher does much more than review already published material, he seeks to discover and to integrate new information which has never been reported and never considered. The concept and process implied in the term 'review of literature' have such different meanings in historical as compared with survey and experimental research.

The term 'review of literature' has been defined in the following ways:

According to Good, Barr and Scates "The competent physician must keep abreast of the latest discoveries in the field of medicine. Obviously the careful student of education, the research worker and investigator should become familiar with location and use of sources of educational information."

According to W.R. Borg

"The literature in any field forms the foundation upon which all future work will be built. If we fail to build the foundation of knowledge provided by the review of literature our work is likely to be shallow and naive and will often duplicate work that has already been done better by some one else."

According to Charter V. Good

"The keys to the vast storehouse of published literature may open doors to sources of significant problems and explanatory hypotheses and provide helpful orientation for definition of the problem, background for selection of procedure, and comparative data for interpretation of results. In order to be creative and original, one must read extensively and critically as a stimulus to thinking."

According to John W. Best

"Practically all human knowledge can be found in books and libraries. Unlike other animals that must start a new with each generation, man builds upon the accumulated and recorded knowledge of the past. His constant adding to the vast store of knowledge makes possible progress in all areas of human endeavour."

In survey and experimental research, the review of the literature serves a variety of background functions preparatory to the actual collection of data. In these research approaches, the literature is reviewed to create the context from the past for the new study to be conducted with new subjects and newly gathered data. In the historical approach, we never ignore the past and, in the sense review of the literature is the method of data collection if 'literature' is used in the broadest possible sense. In this regard the sources used are the 'subjects' of the research and the material reviewed of the 'data'. Therefore, the primary function of the review of literature in the historical research is to provide the research data.

Reviewing the literature has two phases. The first phase includes identifying all the relevant published material in the problem area and reading that part of it with which we are not thoroughly familiar. We develop the foundation of ideas and results on which our own study will be built. The second phase of the review of literature involves writing this foundation of ideas into a section of the research report. This section is for the joint benefit of the researchers and readers. For the researcher, it establishes the background in the field. For the readers it provides a summary of the thinking and research necessary for them to understand the study.

NEED OF REVIEW OF LITERATURE

The review of literature is essential due to the following reasons:

1. One of the early steps in planning a research work is to review research done previously in the particular area of interest and relevant area quantitative and qualitative analysis of this research usually gives the worker an indication of the direction.
2. It is very essential for every investigator to be up-to-date in his information about the literature, related to his own problem already done by others. It is considered the most important pre-requisite to actual planning and conducting the study.
3. It avoids the replication of the study of findings to take an advantage from similar or related literature as regards, to methodology, techniques of data collection, procedure adopted and conclusions drawn. He can justify his own endeavour in the field.

4. It provides as source of problem of study, an analogy may be drawn for identifying and selecting his own problem of research. The researcher formulates his hypothesis on the basis of review of literature. It also provides the rationale for the study. The results and findings of the study can also be discussed at length.

The review of literature indicates the clear picture of the problem to be solved. The scholarship in the field can be developed by reviewing the literature of the field.

OBJECTIVES OF REVIEW OF LITERATURE

The review of literature serves the following purposes in conducting research work:

1. It provides theories, ideas, explanations or hypothesis which may prove useful in the formulation of a new problem.
2. It indicates whether the evidence already available solves the problem adequately without requiring further investigation. It avoids the replication.
3. It provides the sources for hypothesis. The researcher can formulate research hypothesis on the basis of available studies.
4. It suggests method, procedure, sources of data and statistical techniques appropriate to the solution of the problem.
5. It locates comparative data and findings useful in the interpretation and discussion of results. The conclusions drawn in the related studies may be significantly compared and may be used as the subject for the findings of the study.
6. It helps in developing experts and general scholarship of the investigator in the area investigated.
7. It contributes towards the accurate knowledge of the evidence or literature in one's area of activity is a good avenue towards making oneself. This knowledge is an asset ever afterwards, whether one is employed in an institution of higher learning or a research organization.

Bruce W. Tuckman (1978) has enumerated the following purposes of the review:

1. Discovering important variable.
2. Distinguishing what has been done from what needs to be done.
3. Synthesizing the available studies to have perspective.
4. Determining meanings, relevance of the study and relationship with the study and its deviation from the available studies.

Edward L. Vockell (1983) has pointed out the following two purposes:

- The main purpose of this review is to put the hypothesis to be examined in the research report into its proper context.
- Secondary purposes of this part of the report are to provide readers with guidelines regarding where they can look to find more information and to establish the author's credential by letting readers know that the researcher is aware of what has been going on with regard to the current and related topics.

The review of literature provides some insight regarding strong points and limitations of the previous studies. It enables him to improve his own investigation.

PRINCIPLES AND PROCEDURES FOR THE REVIEW OF LITERATURE

The following is the specific procedure through which review can be done appropriately:

1. It is generally advisable to get first and over all view by consulting a general source, such as a text-book which is more likely to provide the meaning and nature of the concepts and variables or theoretical framework of the field. The logical starting point is to get a clear picture of the problem to be solved. A text-book usually provides the theoretical aspects of the problem. It is very essential to develop deep understanding about the variables and the field.
2. After developing the insight about the general nature of his problem, the investigator should review the empirical researches of the area. The best reference for this phase is the handbook of research. Encyclopaedia of Educational Research, the Review of Educational Research and International Abstracts for more upto-date findings.

   The researcher's major concern at this point should be to get a clear picture of the field as a whole; specific details are important at this stage. He should start from a topical outline and a temperature set of classifications, so that whatever he reads can be made meaningful.
3. The research for library material must be systematic and thorough. The investigator generally should start by collecting his references from the educational index. When a large number of references are to be copied, they should be typed because precision is required here.
4. The researcher should take note systematically in the light of such criteria as uniformity, accuracy and ease of assembly. The notes should be taken on the card. Each entry should be made separately; references should be recorded with complete bibliographic data. It should be recorded on front side of the card and content should be taken below and reverse side of it. Each note should be recorded carefully and accurately.
5. The investigator should take as complete notes as he might need. On the other hand, taking unnecessary notes is wasteful. The useful and necessary material should be recorded precisely. It would be better that similar sources are gathered.

   It is necessary that a general education of each source, rather than simply a summary of its content be made. Such evaluation is necessary both in presenting the study in the review of literature, and in using the study as background for the interpretation of the findings of the study.
6. A major pre-requisite for effective library work is the ability to read at high speed. This can only be developed through practice. He must learn to skim material to see what it has to contribute to the study, only after its reference has been established, it should be read in detail. Surveying the literature for the purpose of conducting research is not just 'a pleasant excursion in the wonderful word of books', it is a precise and exacting task of locating specific information for the specific purpose.
7. The actual note-taking process is always a difficult task for the researcher. He has to spend long hours in the library taking notes by hand. It is a very tedious job and leads to importance to carelessness and illegibility. He should make use of the facilities available in the library for this purpose.

THE NATURE OF THE REVIEW OF THE LITERATURE

Through a process of integration of post research and thinking with current research and thinking, we move knowledge forward. For this process to function successfully, each researcher must know the past so that he can design research to build on what is already known and study what is not. There are times when researchers lack this knowledge. We see researches are being done on matters which have been demonstrated sufficiently so as not to need further replication. When this is done the research becomes an academic exercise of little interest in consequence to the discipline involved. We also see research into the unknown which does not build on the known. In a sense this is the greater professional loss. Needless repetition is only a waste of the researcher's time, money and energy, but new research which is unconnected to previous thinking and research is a lost opportunity to move knowledge forward. When new research is not based on a thorough review of the literature, it becomes an isolated entity bearing at best accidental relevance to what has gone before. When it is based on the literature, we can hope for cohesive and integrated approaches to our problems and for resolution and solution of them through research.

Reviewing the literature has two phases. The first phase involves identifying all the relevant published material in the problem area and reading that part of it with which we are not thoroughly familiar. As we read what others have done and/or thought about the problem area, we gradually develop the foundation of ideas and results on which our own study will be built. The second phase of the review of the literature Involves writing this foundation of ideas into a section of the research report.

A distinction must be made between the literature that is reviewed, that is, read by the researcher, and that which is discussed in the study itself, that is, referred to in the section or chapter headed "Review of the Literature." The amount that anyone researcher needs to spend on anyone problem is determined by the unique combination of the problem which delimits the total amount of knowledge needed and how familiar the researcher may be with none, some or even all of that knowledge. The section in the research report discussing the literature is different matter. For the researcher, it establishes the framework or background in the field and thus, provides the setting in which he reports the new study. For the reader, the section provides a summary of the thinking and research necessary for him to understand the study. It also gives the reader a good estimate of the researcher's scholarliness. One basis for this estimate is the researcher's ability to distinguish the relevant from the irrelevant.

How important this stage will be in the development of the researcher's thinking, depends, of course, on the richness of the literature. There are problem areas in education, psychology, and sociology, and in all branches of knowledge in both the social and physical sciences in which there is little literature. The researcher's obligation is to search the literature, find what exists, and review it. 'He is not responsible for previous generations' disinterest or neglect of a problem area, and so if his search yields little, he is entitled to say this. In this case, the written section will simply be a brief statement, identifying the extent of the search, naming the sources consulted, and reporting how little was found.

But let us assume that there is a literature in the problem area. Then the amount of time devoted to this stage of the research depends upon how well the researcher knows the problem area and literature. If he knows the area well and keeps his knowledge current, then he will need only a once-aver-lightly review to be certain that he is aware of the latest research and thinking. In all other instances, where a researcher has less than complete current knowledge, a thorough review of the

literature is needed ranging to the deep and extensive review needed by the researcher working in a problem area new to him.

SOURCES OF REVIEW OF LITERATURE

There are various sources of literature which may be used for this purpose. These sources can be broadly classified into these heads. (1) Books and Text-Books material. (2) The Periodical literature, and (3) General references.

1. Books and Text books Material

The most useful list of books published in the English language is the Cumulative Book Index and Book Review Index, Books Review Digest, Subject Guide to Books indicates that books are in print or press or forthcoming books. National Union Catalogue is also useful for this purpose. There are a number of publications that locate specific references that cover particular area of knowledge. The Cumulative Book Index is published monthly to provide the references, all books published in the English Language.

Sources of Information in the social sciences 'organized' by subject area and indexed by author and title, this work contains comprehensive list of reference books and monographs.

2. Periodicals

A periodical is defined as a publication issued in successive parts, usually at regular intervals, and as a rule, intended to be continued indefinitely. These include Yearbook, Documents, Almanacs, The Cumulative Book Index, International Abstracts, Journals, Newspapers, Magazines, International Index to Periodicals.

Periodicals are generally placed in open shelves in the Periodical room. Their effective use is predicted on the use of an index to identify the articles on subject matter under the study.

The Education Index has served as a comprehensive index of practically all publications in the area of education.

Education Index. New York, published monthly.

Canadian Education Index, Ottawa published by the Council of Education.

Current Index of Journals in Education, New York, it is published monthly. Index of Doctoral Dissertations International. Ann Arbor, it is published annually and consolidates all dissertations accepted American, Canadian and European Universities.

Bibliographic Index, New York, this guide indexes by subject current bibliographies of published books and educational periodicals both in English and in foreign languages.

3. Abstracts

Another type of reference guide is the abstract, review, or digest. In addition to provide a systematized list of reference sources, it includes a summary of the contents. Usually the brief summaries of research studies are given in the form of abstract Educational abstracts, International abstracts in humanities.

ERIC Educational Documents Abstracts, Washington DE., this annual publication includes abstracts of all reports which appeared in Resources in Education for, the year. Education Abstracts, psychological Abstracts and Sociological Abstracts are published including research studies in these disciplines.

A wide variety of indexes and general references can be found to cover almost any area in which the modern researcher might be interested.

4. Encyclopaedias

Encyclopaedias provide concise information on a number of subjects written by specialists. They provide a convenient source of information, and often include illustrations and bibliographies. Only specialized encyclopaedias deal with restricted areas of knowledge.

Encyclopaedia of Educational Research, New York. It is published, every ten years. It refers to important work on educational problems.

5. Almanacs, Handbooks, Yearbooks and Guides

This general category of references includes those publications that present rather detailed up-to-date information on a variety of subjects, organized around a given theme. They are the types of references that one consults to find specific information, often of a statistical nature. Generalized sources are listed first, followed by those with a more specialized emphasis.

'World Almanac' Book of Facts, New York: It is source of miscellaneous information of various subjects.

'Handbook of Research on Teaching' Chicago: It provides comprehensive research on teaching within depth and extensive bibliographies.

'Education Year Book', New York: It is annual publication which includes statistical data on major educational issues and movements with an extensive bibliography and reference guide.

'Year Book of Higher Education' : It provides upto-data information on all aspects of higher education in U.S.A., Canada and Mexico.

Mental Measurement Year Book, Highland Park: It provides the most comprehensive summary on psychological measurement and standardized tests inventories. It is published every four years.

6. References on International Education

This type of publications deals with education outside the United States.

'The World Yearbook of Education', New York: It is issued annually and prepared under the joint responsibility of University of London and Teachers College of Columbia University, each issue is devoted to some aspect of international education.

'Inter-national Yearbook of Education', Geneva: The Yearbook presents in English and French a review of educational development for the previous year in the United States, Canada and more than 40 foreign countries.

'Educational Documentation and Information', Geneva: It is a quarterly issue which provides short-descriptive articles on national, international institutions, documentation and research.

'International Handbook of Universities' Paris: This book describes universities and other higher institutions of bearing in more than 100 countries of the world and the British Common wealth. It provides information about facilities, history, structure, academic year, admission, scholarships degree programme, libraries, teaching staff, publications and language of instruction. There is also a publication 'Common wealth Universities Yearbook.' Edinburgh which provides information of universities in 23 Common wealth Countries.

'Higher Education in Developing Countries.' Cambridge: It is a selected bibliography on students. politics and higher education.

7. Specialized Dictionaries

There are specialized dictionaries of education which includes terms, words and their meanings.

'Dictionary of Education,' New York: This educational dictionary covers technical and professional terms. Foreign educational terms used in comparative education writings are also included.

Government of India has also prepared a 'Dictionary of Education' which includes technical and professional terms from English to Hindi.

The educational worker often needs information about another educator or a prominent" person outside the field of education. These are essential to conduct an educational research. It requires biographical and auto-biographical references.

8. ERIC (Educational Research Information Centre)

The current knowledge explosion makes selective data retrieval the key to the research enterprise as well as to effective educational practice. The major developments in this regard as they relate to the educational literature are ERIC (Educational Research Information Centre) and SRIS (School Research Information Service). ERIC is an attempt to facilitate information exchange and to increase the value of research to the educational community by simply making its results readily available in usable form. A related service in SRIS initiated to provide and ERIC type coverage of educational materials.

In our country NCERT has established a separate ERIC cell to facilitate educational research community.

9. Microfiche

The development of the microfiche has been one of the most significant contributions of library services by providing economy and convenience of storing and displaying of scholarly material.

A microfiche is a sheet of film containing micro-images of printed material. A copy of film 4″ × 6″ card countries the material of one hundred printed pages of 9″ × 11″ size. There are many document-reproduction services that supply microfiche to libraries upon special order.

Super-and Ultra Microfiche is the recent development in the field of micro-printing. It has transformed the process of storage of published material in libraries of the future. A super microfiche has been developed that contains upto two pages of printed material on a single 4″ × 6″ transparent card, the equivalent of two or more books. An even more spectacular development is the ultra- microfiche that contains upto 3200 micro-dots on a single card of 4″ × 6″. When projected each dot contains the equivalent of several pages. Thus, seven to ten volumes can be included on a single 4″ × 6″ transparent card. Reader printers make hard copy points out of any page in few seconds.

10. Dissertations and Theses

The theses and dissertations which embody the bulk of presenting educational research, are usually housed by the institutions and universities that award the authors their advanced degrees. Sometimes these studies are published in whole or in part in educational journals. The related dissertations and theses are the main sources of review of literature. the entry 'dissertations and theses' issue of the bibliographic index in the most comprehensive listing of sources to these research in progress.

11. Newspaper

The current newspapers provide upto-data information and speeches, reports. conferences. new developments in field of education. The current events and educational news are also reported in newspapers. It is also one of the important sources of review of literature.

Exploring the literature moves the researcher to the frontiers of knowledge where he can evaluate new findings in his field, gaps in knowledge contradictory findings and identifying needed research. He will be familiar with methods and bibliographies that may prove useful in his own investigation.

THE FUNCTIONS OF THE REVIEW OF LITERATURE

There are five functions of review of literature :

1. The conceptual frame of reference for the contemplated research.
2. An understanding of the status of research in problem area.
3. Clues to the research approach, method, instrumentation and data analysis.
4. An estimate of the probability of success of the contemplated research and the significance or usefulness of the findings and, assuming the decision is made to continue.
5. Specific information required to interpret the definitions, assumptions, limitations and hypotheses of research.

The detailed description of these functions have been given in the following paras:

1. Conceptual Frame of Reference

The first function, provides the conceptual framework of research which involves both conceptual and research literature. The most direct way of doing this is to read the basic writings in the field as well as the recent writings of key thinkers. The researcher must feel fully satisfied when he has completed this phase of his view that he is aware of all the points of view in the field and particularly that he has devoted himself diligently to learning about the points of view which differ from or are opposite to his own. All points of view relevant to the research problem should be presented as strongly as the most devoted proponents of that point of view would wish.

The first function of review of literature provides the sound conceptual framework of the research problem. He should feel that, in a debate or seminar, he is able to represent any point of view fully, in the sense that he has come to understand the arguments for that point of view.

2. Status of Research

The second function of the review of the literature is to provide an understanding of the status of research in the field. This comes from reviewing the research literature. This phase has several specific sub-functions which can be described in terms of the questions words: what, when, who and how. These four words provide the basic infromation which reveals the status of the research in hand.

First, through his review of the research literature the researcher learns what researchers have already been undertaken and completed in the problem area and the results that this research has already achieved. The unnecessary repetition can be avoided. Learning about research in progress is difficult to locate. Within specific university or the experts of research degree committee can help in this direction.

The other aspect of what, learning the results of previous research, is the best known purpose of reviewing the literature. We are more interested in learning about previous research than the result. After intensive review of conceptual and research literature in such an area, a researcher may develop confidence that he has an explanation for the inconsistencies.

In addition to learning what has been done, the researcher seeks to identify when the research has been done, specifically how current research has been done, specifically how current research in the

problem area is. There are periods of time in which a great deal of research is done in the problem area. Learning when previous research has been conducted has several meanings for researcher:

- It will determine how far back chronologically his review of the literature will follow.
- When there is a wealth of recent research in the problem area.
- When there has been a recent lack of interest in the field, he will need to go further back until he comes upon the research.
- Replication is sensible when a research study has provided the basis of some current belief that the findings still hold true.

With 'what and when' considered, let us consider the importance of 'where', that is, identifying the geographic areas in which the previous research has been completed. The major categories within this classification are national, regional, and degree of urbanization. Typically, educational research reviewed by researcher is limited nationally of Indian conditions, in that it consists of previous research done in this country.

The importance of the second category, region, depends on the problem area. For some area, primarily those in educational psychology, studying human characteristics and basic behaviour, region would seem irrelevant. For example, in research in the learning process, it seems sensible to ignore region of the country, and instead to accept the assumption that people learn through the same psychological processes in India as they do in the U.S.A. However, when the research moves into areas involving attitude, patterns administrative policy or educational history, despite the large common areas, it is not possible to assume that the regions of India present relatively the same research settings. They differ in such varied areas as the origin and tradition of the schools and, reflecting climatic and economic differences, in the length of the school as well as in the months which children spend in school. They differ also in levels of achievement, as reflected in the different regional standards of national competitive examinations like the Merit Scholarship Examination. For this reviewing research in these areas, the researcher will take careful note of the regions of the country in which the previous research has been conducted. Then he will have to decide whether or not this research applies to the region of his own research and use it accordingly.

It is important to recognize that research of national scope is now feasible to a much greater extent than was possible' only a few years ago. This is true both because of increased knowledge and facilities for obtaining research data from a broad geographic area and because of increased facilities for processing means of data quickly and inexpensively.

Much the same set of arguments can be applied to the third category, degree of urbanization. This, like region, is a characteristic whose importance depends upon the problem area. The degree of urbanization of the community in which research is done may vary from rural communities at one extreme to large metropolitan centres at the other extreme. The most cursory review of the educational literature will indicate that the preponderance of research in every problem area has been done in metropolitan settings. Thus, the researcher designing a project to be conducted in metropolitan centres will find similar research settings in the literature; the researcher designing a project with a rural setting will find little. Perhaps the most discussed area at present is the education of the culturally disadvantages child. Reading the literature one would assume that culturally disadvantaged children live only in urban centres. In fact, the educational problems they pose have a much longer history in rural settings.

The solution of this, of course, is to consider not only where previous research was conducted but who was studied. This means identifying the universes or populations which have previously been studied, how they were sampled, and the extent of the sampling. Here the researcher is interested in the

broad general levels of universes studied, as well as in the specific populations sampled. For instance, the researcher in education will seek to determine how much of the research in the problem area involves pupils, teachers, parents, administrators, or the public. He will also want to identify which groups of pupils; elementary or secondary, first graders, second, or third? Finally, he will want to note the size of the samples used. Has the researcher in the problem area typically used small samples or large samples? Is there a study which had usually broad population and substantial sample size ? To what extent has population been stratified on variables like socio-economic background, intelligence, sex, interest, and achievement in the problem area? Finally, if he has even tentatively identified his own population. he will be interested specifically in the extent to which there has been previous research on that population.

One purpose of this consideration of the 'who' of previous research is to enable the researcher to make a judgement as to the relevance of a universe and population for his own research. Theoretically, he would advise students not to plan to study those universes or populations which have already been sufficiently studied in the problem area, either at the general or specific level. In reality, with the current status of research in most problem areas in education and the social disciplines, this is not a difficulty as there are no problem areas in which populations have been sufficiently studied.

3. Research Approach, Method, Instrumentation and Data Analysis

This function of the review will serve the third function of providing clues of methodology and instrumentation. Specifically, the researcher will want to learn the extent to which previous research in the problem area has utilized the historical survey, or experimental approaches, because this will help to guide his own choice of research approach. For this same reason, he will want to identify the research methods which have been used so that experience with these can help him select his own. Finally, he seeks to become familiar with the data-gathering instruments which have been used so that if an already existing instrument is appropriate, it can be used intact or adapted for his own research.

For this consideration of the how of previous research the researcher should be as interested in identifying the rationale for the selection of a particular approach method, or instrument. Furthermore, he should also be interested in what alternative approaches methods and instruments were considered and/or tried out and why these were rejected. Unfortunately the rationale for the selection of research approach method, and instrument, and the thinking that motivated the rejection of alternatives. is generally omitted from the research literature in every branch of the social sciences.

In addition to learning rationals for method as fully as possible to completely serve the third function of the review of literature providing clues to methodology and instrumentation, the researcher should know what methods and techniques have been used in his problem area and the success achieved with each. Depending on his purpose in doing research he may decide to use a technique which has been shown to function successfully or to try one which has not been used before in the problem area. He would not try techniques which have been unsuccessfully unless he had specific reasons to believe that his use of the method was significantly different from previous attempts.

In the third function of the review of literature, the review of instruments parallels the review of techniques in that area, too, the researcher is seeking to learn what has worked and what has not. If he is fortunate enough to discover a successful instrument which he can use this is preferable to developing a new instrument for two reasons. It establishes continuity between the new research and the previous research and it spares the researcher the time-consuming and difficult job of instrument development. Even finding an instrument which can be adapted to the needs of research is a tremendous advantage.

Again, we must put in a realistic qualification. Most journals which report research do not print the actual instruments. Often these do appear in the appendix of the complete research report or thesis or dissertation on which many journal articles are based, or else can be obtained directly from the author of the article. The simplest procedure is usually to contact the author directly, since in any event he will be contacted for permission to use or adopt any instruments he has developed.

It is important to distinguish between what are generally considered standardized instruments and those specially developed for some previous research project. Standardized instruments are those which have been used widely enough for normative data to be available. The process of standardizing instruments also provides data on reliability, and sometimes on the availability of the instrument. The availability of these three kinds of data norms, estimate of reliability, and estimate of validity make standardized instruments attractive to researchers, particularly to students doing research. These attractions are quite real using an instrument with norms and established reliability does have great advantages when these data have been obtained from samples from the same universe as we plan to study.

Another instance where the availability of normative data is not enough of an advantage to use an instrument is when the literature indicates that, although standardized data are available, the previous research provides little hope that the instrument will produce meaningful data. For too often in the literature we find studies which use standardized instruments in instances where it was obvious they would not function.

The discussion above on these first three functions of the review of the literature for survey and experimental research should also imply what it is that the researcher is seeking as he reads. For the first, or overview function, he is concerned with identifying each point of view and supporting arguments and evidence for that point of view. For the second function, the status of research, he will do much more structured and specific review, concerned with identifying what was studied, the outcomes of each study, how the outcome of the several separate studies relate to each other, who had studied and where, and when the research was done. For the third function, clues to methodology and instrumentation, he is concerned with how the previous research was done and why it was done, the way it was.

In a sense, it is the combination of these first functions which yield the fourth and fifth functions of the review of the literature.

4. Probability of Success and Significance of Findings

With the full body of the previous research reviewed, the researcher is in a position to evaluate the success which others have had done research in the problem area and the usefulness of their findings. If others have been successful and the findings are useful, then the prognosis for his own research is good, and the decision to continue on with the research is clear and simple to make. However, if others have been unsuccessful and produced inconclusive research or research of little value, then the researcher has a more difficult to make decision. He must ask himself whether there are specific reasons to believe that he can succeed where all others have failed. For the literature truly to serve this function of providing as estimate of the success potential of the contemplated research, the researcher must be willing to make the negative decisions to abandon or alter the project, as well as the positive ones to continue on as intended. All too often in research, only lip service is paid to this function. Researchers do review the literature and do seek to determine the success potential of their contemplated research, but never truly entertain the possibility of altering or abandoning their plan. If no one has ever succeeded in doing what they plan, they argue that they must be the first. This author would say more power to

them, and would be the first to cheer their courage provided it was based on something more substantial than hope.

If the researcher has some new idea, some new method, some new instrument, which leads him to believe he will succeed where all others failed, then he has every right to proceed. However, if he only intends to try again what has never worked before, then he should seriously consider whether he can reasonably except to do any better than his predecessors. If not, he should devote his time, energy, and ability to a research problem in which there is a greater likelihood of his making a positive professional contribution.

5. Definitions, Assumptions, Limitations, and Hypotheses

After considering the literature the researcher can honestly conclude that there is a reasonable expectation that he will successfully complete the contemplated research with results that will make a contribution of his field. Then he will use the material from the literature as the basis for stating his definitions, assumptions, limitations, and hypotheses. Having read the works presenting opinion and theory in the problem area, and having reviewed the relevant research as well, the researcher should be thoroughly familiar with the way in which terms have been used, both in the theoretical sense in the conceptual literature, and in the more functional sense in the research literature. Thus, he should be able to formulate the definitions for his contemplated project. Where possible and sensible, he should use the definitions which have previously been used in the literature, because this is one way of making old and new research comparable. Where necessary. however, he is free to adapt previous definitions or formulate new ones. The essential point is that this be a knowledge decision made with full awareness of how key terms have been used previously.

In the same way that the review of research makes the researcher aware of how terms have been used, it (the conceptual review as well) should have made him aware of those aspects of the problem area which have been so well demonstrated by previous research that they are widely accepted as true. These he can use as the assumptions of his on research. Finally, he should have become sufficiently attuned to the controversial or open-to-question aspects of the problem area. Then, as he plans his research, he can be alert to which of these aspects he can or which he cannot handle in his own project. Those he cannot handle will form the basis for the statement of limitations of the research.

His awareness of the results of previous research, and his knowledge of the current thinking in the field, can now be combined with his own experience to produce the statement of the hypotheses, or expected results of the research. In addition of identifying the expected outcomes of his study, the researcher should identify the bases in the literature for each specific belief. In this way in both the outline and the report of his project, he can state the rationale for each hypothesis, identifying the theorist, previous research study, personal experience, or combination of these which leads him to expect this particular result.

In addition to the five direct functions discussed above, we can identify one indirect function of the review of the literature; to serve as a sounding board to help the researcher know when his research problem has been sufficiently specified. This function can best be described in terms of two different feeling tones. The first feeling tone is one in which the researcher finds that, simultaneously, all of the literature seems relevant or none of it seems relevant. This is the feeling tone characteristic of the early stages in problem development when the research problem is insufficiently specific. As the problem is specified, however, and the researcher continues to read, a subtle change takes place. He now finds that certain articles or studies have a striking and exciting relevance; others while possibly in the same problem area, are not directly related. When he experiences this feeling as he reviews the literature,

then he knows that the research problem is approaching sufficient specificity. We can restate the general rule mentioned earlier. As long as this judgement of relevance is difficult to make, the literature is reflecting insufficient clarity and/or specificity in the research problem.

HOW TO CONDUCT THE REVIEW OF THE LITERATURE

The place to begin a review of the literature varies, depending upon how familiar the researcher is with the problem area. As we stated earlier, the thoroughly well-read researcher will need to complete only a brief review of the latest writings and research. Since this researcher will also know the major thinkers and sources of research in the field, he does not usually need help in conducting this brief review. This section then, will assume that the researcher is not an expert in the problem area and discuss how the non-expert reviews the literature.

The non-expert should begin by reviewing the conceptual literature, for it is more comprehensive than the research literature and will provide a better overview of issues. An excellent place to begin is with a general text in the problem area in an encyclopaedia or review of recent works. In education, we have excellent general texts in almost all areas as well as general encyclopaedias like the Encyclopaedia of Modern Education and the Encyclopaedia of Educational Research, and more specific works like the Encyclopaedia of child Care and Guidance or the Yearbook of the National Society for the study of Education.

When the research problem has been specified, the researcher should take stock of his reading to date, particularly appraising its relevance in the light of the newly specified research problem. He will want to ascertain whether the conceptual literature already reviewed provides a thorough conceptual framework for the specific problem that he has new decided upon, or whether further work is needed in the conceptual literature. In other event, however, he will also want to move on new to the research literature, and begin to see the what, when, where, who and how of previous research on his specific research problem.

In the course of reading the conceptual literature he will have come upon references to research studies. These may be a good first set of studies to locate and read, preferably as complete report. But usually at some point, his list of references is exhausted and the non-expert will seek other references from the mass of the published literature. We are fortunate in education in having available several basic tools to use for reviewing professional literature, such as the Education Index, Child Development Abstracts, Psychological Abstracts, sociological Abstracts, and parallel tools for the lay literature such as the Cumulative Book Index, and the Reader's guide to Periodical Literature.

In fact there are two guides to reference books and a book on how to locate educational information. These, and the most frequently used indexes and abstracts are listed above, with a brief summation of the main function, purpose, and organization of each. The researcher not already familiar with all of these resources should make it a point to become familiar with each of the sources listed, since at some point in most research, any or all of them might be useful.

The non-expert begins this phase of his review by using the index or abstract most relevant to his problem area. For example, for the researcher interested in developing a research project in the area of teacher-education in the elementary school, the most relevant index is the Education Index. As noted in the list above, this is an alphabetical topical index issued monthly which lists under each topic recent relevant books and journal articles. To use the Education Index in the review of the literature for the teacher-education study, the non-expert would take the specific problem on teacher-education, also

listing several related terms like “teaching practice” criteria of admission, and “identifying teaching skills” and go to the Education Index, pick up the most recent bound volume, look under these headings, and copy every title appearing there which seems to have relevance for the problem.

SOME HINTS FOR REVIEW OF LITERATURE

Some miscellaneous hints are provided here on how to review the literature. First additional library sources will be helpful, such as Specialized dictionaries and biographical references. The dictionaries, of course, are most useful in formulating the research definitions, but also of value in making certain that we understand all of the concepts that we discover in the literature. It is a good policy to verify our understanding of all important terms and concepts, even those which are familiar. We may have enough grasp of the term to use it in conversation, yet not understand it well enough to use it in research. The listings of thesis and dissertations provide the most complete and current contact with a large part of the research done in colleges and universities, much of which is not published and so never indexed or abstracted.

A second hint is to realize that reviewing the literature is essentially the library phase of the project, and so we must become thoroughly conversant not only with the way in which libraries in general function, classify, and catalogue, but also with the way in which the specific library in which we work does these things. Obviously, we must become thoroughly familiar with the general catalogue and Library of Congress cataloguing system/Individual libraries differ. Therefore, the simplest procedure is to thoroughly familiarize ourselves with, the rules and techniques of the libraries in which we shall do our bibliographic research. Most libraries have staff available to give an overview of the procedure and rationales by which the library material is catalogued and organized, and we should take advantage of this advice. Trial and error at this stage is needlessly wasteful of that precious research commodity, time, and so is to be avoided.

A third hint is to recognize that there are only two criteria for good bibliographic research; accuracy and consistency. Therefore from the very beginning of the review of the literature it is sound practice to begin recording the essential information accurately and in exactly the same way.

A fourth hint is to copy direct quotations and not paraphrases of an author’s remarks on the bibliography cards. It is impossible at the early stage of the research to know in what form we will want to use an idea abstract from the literature. If we have it transcribed directly, we can use it later in our report either as a quotation or paraphrased. If, however, we only paraphrased it and later want to use the quotation, we must make a wasteful and unnecessary trip to the library. When a quotation is put down on the bibliography card, be certain to note the page number of the book or journal on which it appears, for this will be needed in referring to the quoted remark.

Consistently, throughout this library phase of the research, we should be over-compulsive in our note taking. If we err, it is far better to err on the side of writing too much than on the side of writing too little.

The one thing we wish to avoid is the necessity, later in the project when time is precious and needed for activities like data analysis and report writing, of having to return to the library to amplify some brief note or verify a half-remembered quotation. In keeping with this thinking, at every stage of the project we should also make a note and keep a record of every information seeking activity in which we engage. This includes correspondence, conversations and discussions on appropriate techniques or methodology with consulting experts. Remember that until the research project is completed and the report written, it is impossible to know what will and will not ultimately prove to have relevance.

We should also be aware throughout the review of the functions of the review of the literature and organize our material under these different functions. This means that as we read we keep in mind that we seek seven major areas of information:

1. Support for the need for our study; its success potential, and its potential significance.
2. Delineation of the major theoretical points of view. Summary of research results.
3. Clues for the hypotheses of the proposed study.
4. The rationale for each hypotheses.
5. The definitions, assumptions and limitations of the proposed study.
6. Clues for methodology and instrumentation.

The final stage of the review of literature is to write that section of the research outline or report based on the review. There are two reasons why at least a draft of this material should be written at the point in time when the review is completed. First of all, our thinking is fresh and complete; it is astonishing how much we forget when we delay writing. Second, the review will be the foundation on which we build the structure of our study, and we should achieve the precision and closure which come only with writing. With this achieved, we are ready to move on to the next step of the research process.

SUGGESTIONS FOR LIBRARY USE

The educational research studies can be classified into two categories; library research and field research. Philosophical and historical researches are known as library research in which review of literature is considered as method of research. The survey and experimental researches are the field research in which review of research is considered as an inquiry or technique research. In both types of studies library is used for the review of literature.

The major difficulty to use library effectively is to take notes and to sit, for a longer time. For this purpose students should use the advantage of modern facilities wherever possible in the libraries.

The following facilities are available in our good libraries:

1. Most of libraries have typing facilities for the use of research scholars at very nominal changes.
2. He should make use of photo-state facilities for maps, charts, diagram or any figure or table. It is available in our libraries at the minimum changes. It is a very economical device from time and money point of view.
3. Another very satisfactory procedure is to dictate notes directly from the references into a portable tape-recorder for transcription at one's convenience.
4. There is inter-library loan facility provided. The research scholar can request the librarian for references or unpublished thesis from other university library.

Notes Taking: It is an art which can be acquired by practice and persistent efforts. The following precautions are to be taken in taking notes from the library :

1. The researcher should be well acquainted with bibliography references, foot-notes and notations are used for reporting a research work e.g. ibid, op. Cit. loc-cit, Journal no. and vol. etc.

2. The library note should not be taken on note-book papers or sheet of paper. He should make use of cards measuring 3″ × 5″ or 4″ × 6″ which are specially prepared for this purpose because they are easy to carry and easy to arrange topic wise.
3. He should make efforts that a card should include only one topic or one reference or one study on one card so that rearrangement may be easier.
4. At the top of the card library number should be noted down, after that author or editor, year of publication, title of the book or journal, publication edition or no. and volume. These should be written below the reference the reverse or back can also be used for this purpose.
5. Each card, when ready should be fitted under a definite heading or topic marked at the top of the card.
6. Notes must be complete, legible and understandable and no gap should be left.
7. Direct quotation should be carefully acknowledged.
8. The appropriate and relevant material should be noted down and he should not waste time for unnecessary material.

PRECAUTIONS IN LIBRARY USE

The following precautions are to be taken in the use of library for review of the literature:

1. Avoid intellectual dishonesty and guard against the temptation of appropriating large portions of the work of another, without acknowledging indebtedness.
2. Guard against being conditioned by the view point of an earlier investigator and the temptation of blindly following his procedure.
3. In certain cases some studies have no needed to be repeated under similar conditions in order to secure an adequate check on the results of the first investigation. Normative survey type of research which deals with current conditions needs to be replicated on a regular interval in order to keep in touch with change and developments.
4. Merely listing of previous studies without reviewing them or giving their characteristics is not enough. A very brief account of each investigation giving at least the result, the method and the sources of data and the year of research must be provided in the chapter of a research report.
5. It is always helpful to arrange the previous studies in chronological order so that the growth of the field is clearly known to the researcher as well as to the readers.
6. A researcher should have good grasp of library procedures which will help him to locate books and references needed by him without wasting most of time and energy. This process can be classified into three categories:
   (*a*) *Preliminary Reading*, for the birds eye view of the whole thing.
   (*b*) *Critical Reading*: The references and material which seem useful as a result of preliminary reading are noted down and are read critically and serious evaluation of the available information and data.

Completion of Bibliography

The bibliography of references which are really significant for the study should be read carefully and noted down systematically.

REPORTING REVIEW OF LITERATURE

Generally review of literature is reported in the second chapter of the thesis or dissertation. The purpose of reporting the review of literature is not to write down research abstracts one by one which is usual practice of the researcher of to-day. It is most difficult and creative job on the part of researcher. The following procedure should be followed in reporting it :

1. The research should go through collected research studies of the field. He should make an attempt to exhaust all sources of review of literature. He should try to evolve a criterion for classifying the studies. The usual or traditional classification is: studies conducted abroad and studies conducted in India in educational research. The educational researches can be classified: on the educational level "(primary, secondary and college); and on the basis of variables of the study.
2. After evolving criterion of classification, these studies, are arranged according to criterion. One type studies review should be reported separately. The similar type of findings should be given in next para, and he should try to relate with to his own study. This procedure should be followed for reporting all types of studies.
3. At the end of review of literature. he should try to summarize in brief to provide a global picture of whole knowledge of the studies. After that he should relate his study to them and evolve gaps. In the end he should show that his study is a derivation from these studies.

SUGGESTIONS FOR REPORTING REVIEW OF LITERATURE

The reviewing of literature is the continuous process. A researcher begins the review of literature even before selecting his problem of research. The review of literature generally helps in identifying and selecting a research problem. If researcher has selected a problem of his own or suggested by some expert; even then he has to review literature for its justification that it is a novel problem. After selecting and defining a problem, he has to formulate hypotheses for the problem. The review of literature provides the rationale or basis for these hypotheses. The rationale for method, sample tools and statistical technique are obtained from the review of the studies. The results and findings are discussed at length with the help of review of literature. The findings of earlier studies may support his formulation or contradict. He has to advance some reasons for it. The review of literature is used from selecting a problem upto reporting the findings of a study.

Second suggestion is that knowledge is increasing or advancing rapidly and research studies are on going process. A research scholar should remain in touch with library literature or the field throughout the period of his research work. He should be upto-date at the time of reporting review of literature and discussing his findings.

The reporting review of literature makes the research study very scientific and up-to-data. It is not only useful in preparing and writing a thesis but mastery of the review of literature develops the scholarship in the researcher. He justifies in any interviews, seminars, conferences and also in his teaching job and professional growth.

EXERCISES

1. Define the term 'Review of literature', how is it different from traditional meaning? Enumerate the objectives and significance of review of literature.
2. Explain the need and functions of review of literature.
3. Describe the role of review of literature in historical research and survey, experimental type of research in education.
4. Enumerate the sources of review of literature and suggestions, for the use of library for this purpose.
5. Describe principles and procedures of review of literature and precautions in consulting library material.

Chapter 4

Foundation of Hypotheses

The second step in the research process of social study is to formulate hypotheses. The hypothesis is a tentative solution of a problem. The research activities are planned to verify the hypothesis and not to find out the solution of the problem or to seek an answer of a question. It is very essential to a research worker to understand the meaning and nature of hypothesis. The researcher always plan or formulate a hypothesis in the begining of the problem.

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 world 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.

Another meaning of the word hypothesis which is composed of two words:

'Hypo' means composition of two or more variables which is to be verified.

'Thesis' means position of these variables in the specific frame of reference.

This is the operational meaning of the term hypothesis. Hypothesis is the composition of some variables which have some specific position or role of the variables i.e. to be verified empirically. It is a proposition about the factual and conceptual' elements. Hypothesis is called a leap into the dark. It is a brilliant guess about the solution of a problem.

A tentative generalization or theory formulated about the character of phenomena under observation are called hypothesis. It is a statement temporarily accepted as true in the light of what is known at the time about the phenomena. It is the basis for planning and action- in the research for new truth.

DEFINITIONS OF HYPOTHESIS

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

1. Hypothesis

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*

2. Hypothesis

A Tentative generalization.

A Lungberg thinks "A hypothesis is a tentative generalisation 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."

3. Hypothesis: Shrewd Guess

According to John W. Best, "It is a shrewd guess or inference that is formulated and provisionally adopted to explain observed facts or conditions and to guide in further investigation."

4. Hypothesis: Guides the Thinking Process

According to A.D. Carmichael, "Science employs hypothesis in guiding the thinking process. When our experience tells us that a given phenomenon follows regularly upon the appearance of certain other phenomena, we conclude that the former is connected with the latter by some sort of relationship and we form an hypothesis concerning this relationship."

5. Hypothesis

A proposition is to be put to test to determine its validity:

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.

6. Hypothesis

An expectation about events based on generalization:

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

7. Hypothesis

A tentative statement of the relationship between two or more variables:

"A hypothesis is a tentative statement of the relationship between two or more variables. Hypotheses are always in declarative sentence form and they relate, either generally or specifically variable and variables."

8. Hypothesis

A theory when it is stated as a testable proposition. M. Verma, "A theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as a hypothesis."

9. Hypothesis

A statement temporarily accepted as true :

Barr and Scates define as, "A hypothesis is a statement temporarily accepted as true in the light of what is, at the time, known about a phenomena, and it is employed as a basis for action in the search for new truth, when the hypothesis is fully established, it may take the form of facts, principles and theories."

10. Hypothesis

A testable proposition or assumption.

George, J. Mouly defines that, "Hypothesis is an assumption or proposition whose testability is to be tested on the basis of the computability of its implications with empirical evidence with previous knowledge."

11. Hypothesis

Tentative relationship of two or more variables either normative or casual:

"A hypothesis is defined as a statement for the tentative relationship of two or more variables. The relationship of the variables may either be normative or causal relationship. It should be based on some rationale."

ASSUMPTION, POSTULATE AND HYPOTHESIS

The terms assumption. postulate and hypothesis occur most frequently in the research literature, but are often confused by research scholars. Hence these terms need clear explanation.

(*a*) **Assumption**: Assumption means taking things for granted so that the situation is simplified for logical procedure. Assumptions are not the very ground of our activity as the postulates are. They merely facilitate the progress of an agreement a partial simplification by introducing restrictive conditions. For example, the formulas of Statistics and measurement are based on number of assumptions. Assumption means restrictive conditions before the argument can become valid. Assumptions are made on the basis of logical insight and their truthfulness can be observed on the basis of data or evidences. The postulates are the basis and form the original point of an argument whereas assumptions are a matter of choice and less use, we make them more free will and our argument be a general proposition or convention.

(*b*) **Postulate**: Postulates are the working beliefs of most scientific activity. The mathematician begins by postulating a system of numbers which range from 0 to 9 and can permute and combine only thereafter. Similarly 'Hull's Theory of Reinforcement's is based on eight postulates of behaviour of an organism. With many people God and Spirit is a postulate of the good life or godly life. Postulates are not proven; they are simply accepted at their face value so that their basic work for the discovery of other facts of nature can begin.

(*c*) **Hypothesis**: A hypothesis is different from both of these. It is the presumptive statement of a proposition which the investigator seeks to prove. It is a condensed generalization. This generalization requires a knowledge of principles of things or essential characteristics which pertain to entire class of phenomena.

The theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as hypothesis.

The hypothesis furnishes the germinal basis of the whole investigation and remains to test it out by facts.

The hypothesis is based on some earlier theory and some rationale whereas postulates are taken as granted true. An assumption is the assumed solution of a major problem. It may be partially true.

The scientific research process is based on some hypotheses. The nature sciences and mathematics are based on postulates. The statistic is based on some assumptions which are considered approximate science. The assumptions are helpful in conducting a research work in behavioural sciences.

OBSERVATION VERSUS SPECIFIC LAND GENERAL HYPOTHESIS

Hypotheses are often confused with observation. These terms refer to quite different things. An observation refers to what is….that is to what is seen. From observation researcher may infer. For example a researcher may go into a school and after looking around. Observe that most of the students are back. From that observation he may infer that the school is located in a poor neighbourhood. Though the researcher does not know that the neighbourhood is poor, he expects that the majority of people living there are poor. Then he has formulated a specific hypothesis setting forth an anticipated relationship between two variables like race and income level. For the test of this hypothesis researcher could walk around the neighbourhood, observes the home and the income levels. After observation he provides support for this specific hypothesis for this researcher might make a general hypothesis. The second hypothesis represents a generalization and must be tested by making observation as was the specific hypothesis. Since it would be impossible to observe all universe or population, thus, the researches will take a sample and reach conclusion on a probability basis for the verification of hypothesis being true or not.

There is some difference between specific and general hypothesis. Specific hypothesis requires fewer observations for testing than the general hypothesis.

For testing purpose a general hypothesis is reformulated to a more specific one.

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 informations.
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.

The functions of a hypothesis may be condensed into three. The following are the threefold functions of a hypothesis:

(*a*) To delimit the field of the investigation.

(*b*) To sensitize the researcher so that he should work selectively, and have very realistic approach to the problem.

(*c*) To offer the simple means for collecting evidences to the verification.

IMPORTANCE OF A HYPOTHESIS

1. *Hypothesis as the Investigator's "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 that lights the way for the research work.

George J. Mouley thinks that Hypotheses serve the following purposes:

1. They provide direction to research and prevent the review of irrelevant literature and the collection of useful or excess data.

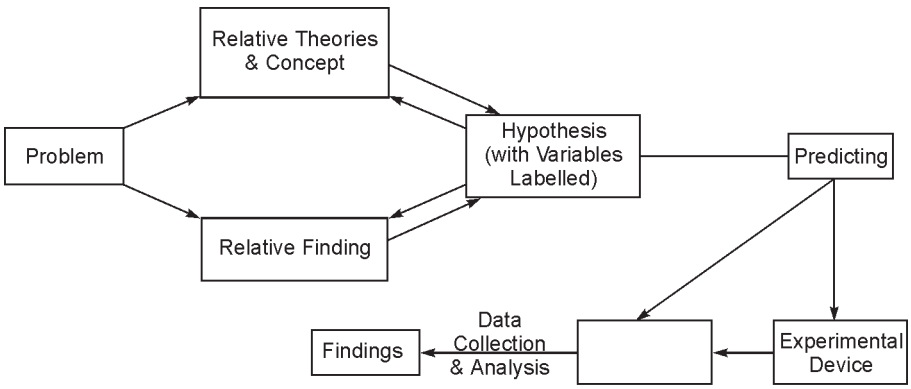
2. They sensitize the investigator certain aspects of situation which are irrelevant from the standpoint of the problem at hand.
3. They enable the investigator to understand with greater clarity his problem and its ramification.
4. They serve as a framework for the conclusive-in short a good hypothesis:
   (*a*) Gives help in deciding the direction in which he has to proceed.
   (*b*) It helps in selecting pertinent fact.
   (*c*) It helps in drawing conclusions.

D.B. 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 a 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.

Bruce W. Tuckman presents the importance of Hypothesis in the Research Spectrum :

Research begins with a problem and utilization of both theories and findings in arriving at hypothesis. These hypotheses contain variables which must be labelled and then operationally defined to construct predictions. These steps might be considered the logical stages of the research. These stages are followed by methodological stages, which culminate in the development of research design and development of measures and finally in the finding themselves.



The Research Spectrum

KINDS 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 determine 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:

Is there a significant interaction effect of schedule of reinforcement and extroversion on learning outcomes?

(*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 a particular anticipated outcomes. An example of the obviously safe hypothesis would be 'hypothesis' 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

H_0 : There is no significant interaction effect of schedule of reinforcement and extroversion on learning outcomes.

H_0 : There is no significant relationship between intelligence and achievement of students.

Recent trend is to employ or develop null hypotheses in research work of education and psychology. A null hypothesis accepted is tentatively to stating that on the basis of evidence tested it could be that there is no difference. If the null hypothesis is rejected, there is a difference but we do not know the alternative or the differences. In this form of hypothesis, researcher has not to anticipate or give the rationale for the declaration or directional form. Secondly, it does not make researcher biased or prejudiced. He can be objective about the expected outcomes of the research or findings.

Actually this is a form of hypothesis but is a statistical hypothesis which is self explanatory-null hypothesis means zero hypothesis. A researcher has not to do anything in developing such form of hypothesis. In the process of reflective thinking research hypothesis is second step whereas null hypothesis is fifth step of research process.

In order to accommodate the object of the inquiry for extracting this information, a null hypothesis is an appropriate form. A null hypothesis does not necessarily reflect the expectations of the researcher so much as the utility of the null form as the best fitted to the logic of chance in statistical knowledge or science.

A statistical hypothesis must be testable within the framework of probability theory. The theory requires one or the other of two hypotheses forms: the 'null' form and the 'delta' form.

The null form is the no difference form i.e. there is no difference or relationship between or among variables under certain conditions.

The 'delta' form for a test hypothesis is simply that A is greater or lesser than B under conditions C, D…..A null form or a delta form which specifies only A and B variables in the relationship permits only a bivariate analysis which is not very sophisticated research analysis. The development of computer assisted data analysis permits the manipulation of a number of variables represented in the C, D..., n conditions of the difference or relationship.

General hypothesis is second step and null hypothesis is the fifth step of research process. Null hypothesis provides the basis of accepting or rejecting the general hypothesis.

General Hypothesis: Programmed instruction is effective then the traditional method in terms of learning outcomes.

General Hypothesis: Structural method is more effective than the lecture method of teaching in English.

Null Hypothesis is a statistical hypothesis which is used in analysing the data. It assumes that observed difference is attributable by sampling error and true difference is zero.

Null Hypothesis	*Programmed Method*	*Lecture Method*
Mean	M_1	M_2
S. D.	σ_1	σ_2
Size	N_1	N_2

$$H_0 \rightarrow (M_1 = M_2) \text{ or } (M_1 - M_2 = 0)$$

The statistical tests of significance are used to accept and reject the null hypothesis. If it is rejected. the general hypothesis is accepted.

Occam's razor has given a principle of economy in scientific explanation which requires for given set of observations so that generalization can be made.

This class of hypothesis is known as null hypothesis so-called because of it 'nullifies' the positive argument of the findings or non-directional statement of the generalization.

This type of hypothesis is also termed as statistical hypothesis or non-directional hypothesis or zero hypothesis because it denies the existence of any systematic principles apart from the effect of chance. This hypothesis assumes that no or zero difference exists between the two population means or the treatments.

$$H_0 \rightarrow (\mu_1 = \mu_2 = 0) \text{ or } (\mu_1 = \mu_2)$$

The observed difference between the two samples means is attributable to chance factor or sampling error.

The symbol He represents the Null-Hypothesis. An alternative formulation of the hypothesis is to assert's that the two samples drawn from population having the same mean. The null hypothesis is a trial hypothesis asserting that no difference exists between population parameters. Thus it involves two types of errors.

	H_0	H_1
Accept	Type I or *A*	Correct
Accept	Correct	Type II or *B*

Two Types of Errors

Type I error (*a error*) : When an alternative hypothesis H_1 may be accepted and H_0 is rejected. It shows that obtained difference exists and not due chance or sampling errors.

Type II error (*b error*) : When null hypothesis H_1 is accepted and alternative hypothesis H_1 is rejected. It indicates that obtained difference is due to chance or sampling error.

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.

VARIABLES IN A HYPOTHESIS

A hypothesis is made testable by providing operational definitions for the terms or variables of the hypothesis. For a testable hypothesis there are two important things :

1. Variables, and
2. Operational definitions.

Variables

There are five types of variables. Among students of the same age and intelligence, skill performance is directly related to the number of practice traits particularly among boys but less directly among girls. In such a hypothesis the variables which must be considered are:

(*i*) Independent variable – number of practice trails.
(*ii*) Dependent variable – skill performance.
(*iii*) Moderator variable – sex.
(*iv*) Control variable – age, intelligence.
(*v*) Intervening variable – learning.

(*i*) The Independent Variable: The independent variable which is a stimulus variable or input operates either within a person or within environment to affect his behaviour. It is that factor which is measured, manipulated. or selected by the experimenter to determine its relationship to an observed phenomena.

If a researcher is studying the relationship between two variables X and Y. If X is independent variable, then it affects another variable Y: So the characteristics of independent variables are:

(*a*) It is the cause for change in other variables.
(*b*) Independent variables are always interested only it affects another variable, not in what affects it.

(*ii*) The Dependent Variable: The dependent variable is response variable or output. It is an observed aspect of the behaviour of an organism that has been stimulated. The dependent variable is that factor which is observed and measured to determine the effect of the

independent variables. It is the variable that will change as a result of variations in the independent variable. It is considered dependent because its value depends upon the value of the independent variable. It represents the consequence of change in the parson or situation studied.

Relationship Between Independent and Dependent Variables: Most experiments involve many variables when two continuous variables are compared, as in correlation studies, deciding which variable to call independent and which dependent is sometimes arbitrary. In such cases variables are often not labelled as independent or dependent since there is no real distinction. Independent variables may be called factor and their variation may be called levels.

(*iii*) The Moderator Variable: The term moderator variable describes a special type of independent variable a secondary independent variable selected for study to determine if it affects the relationship between the primary independent variable and the dependent variable.

The moderator variable is defined as that factor which is measured, manipulated or selected by the experimenter to discover whether it modifies the relationship of independent variable to an observed phenomena. The sex and rural urban generally function as moderator variables.

(*iv*) Control Variable: All the variables in a situation can not be studied at the same time, some must be neutralized to guarantee that they will not have a differential or moderating effect on the relationship between the independent and dependent variables. These variables whose effects must be neutralized or controlled are known as control variables. They are defined as those factors which are controlled by experimenter to cancel out or neutralize any effect they might otherwise have on the observed phenomena. While the effects of the control variables are neutralized, the effect of moderator variables are studied.

Certain variables appear repeatedly as control variables, although they occasionally serve as moderator variables. For example sex, intelligence and socio-economic status are three subject variables that are commonly controlled, noise, task order and task content are common control variables in the situation.

(*v*) Intervening Variable: Each independent, moderator, and control variable can be manipulated by the experimenter and each variation can be observed by him as it affects the dependent variable. Often these variables are not concrete but hypothetical, the relationship between a hypothetical underlying or intervening variable and dependent variable.

An intervening variable is that factor which affects the observed phenomenon but cannot be seen and measured or manipulated, Its effect must be inferred from the effects of the Independent and moderator variables on the observed phenomena. The attitude, learning process, habit and interest function as Intervening variables.

Hypothesis

Teachers given more positive feedback-experiences will have more positive attitudes towards children than teachers given fewer positive feedback-experiences.

Independent Variable–Number of positive feedback experiences for teacher.

Intervening Variable–Teacher's self esteem or habit pattern.

Dependent Variable–Possessiveness of teacher's attitude towards students.

The researcher must operationalized his variables in order to study them and conceptualize his variables in order to generalize from them. Researchers often use the labels independent, dependent,

moderator, and control to describe operational statements of their variables. The intervening variables always refer to a conceptual variable that which is being affected by the independent, moderator control and dependent variables.

The intervening variable can often be discovered by examining a hypothesis. They are usually abstract in nature.

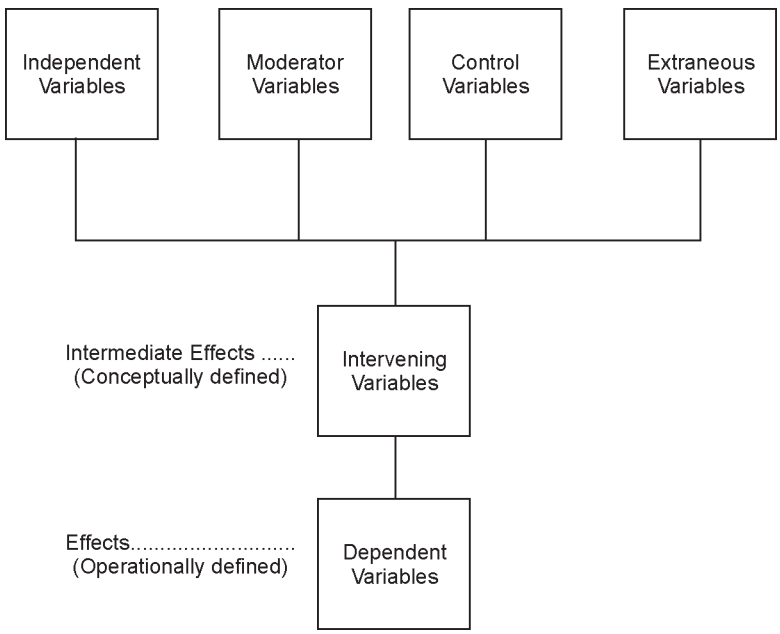
Independent, moderator and control variables are inputs or causes, the first two being these that are studied while the third, control variables are neutralized or 'eliminated'. At that other end, dependent variables represent effects or it is also known as criterion variable while intervening are conceptualizations which intervene between operationally stated causes, and operationally stated effects.

The Research Variables Combined

The various research variables interact among themselves. The Independent, moderator, and control variables are under the researcher's control. They cause an impact within the subject. The impact is referred to as the intervening variable. In addition, the extraneous variables have an impact upon this Intervening variable. Such extraneous variables are not under the researcher's control, their presence weakens a study. One of the goals of a researcher is to remove as many significant factors as possible from the extraneous variables category by bringing them into the categories of moderator and control variables. Such a process of removing extraneous variables strengthens a study.

The Variables in the Research Process

Causes (*operationally defined*)



The intervening variable is merely hypothesized. It is abstract in nature. It cannot be visually observed. It is defined in conceptual terms. It is produced by some combination of the casual variables in the top row of the figure. It produces the effect or dependent variable. Every experimental study has at least one independent variable and one dependent variable. Both of these variables should be explicitly

stated in the hypothesis and in the research predictor. If either the treatment or the outcome variable is too complex to be stated succinctly, further operational definitions of these variables can be included in the methods section of a report. Every study has also an intervening variable, and often there can be more than one intervening variable. The intervening variable is, not stated in operational terms, but rattier conceptual explanation for the observed results. Intervening variables are normally not stated in the hypothesis or research prediction. Sometimes intervening variables are only vaguely described or are not mentioned at all.

Every study does not contain moderator and control variables. When such variables are contained in a study, they should be operationally defined. Moderator and control variables are stated in the research hypothesis and in the research prediction. Often the operational definitions further explanation in the method section of a report.

Identify each of the research variable from the following hypothesis-

High school students who study English for two years will develop better, Hindi vocabulary, skills than those who do not study English. Independent Variable - Studying English vs. not studying it.

Dependent Variable – Vocabulary skills.

Moderator – Hindi class placement (advanced vs. non-advanced).

Control – High School students.

Intervening variable – Increased ability or learning style.

Some Considerations For Variables Choice

After selecting the independent and dependent variables the researcher must decide which variables are to be included as moderator variables and which are to be excluded or hold constant as Control variables. He must decide how to treat the total part of the other variables (other than the independent). That might effect the dependent variables. In making these decisions which variables are 'in' and which are 'out' he should take into account three kinds of considerations:

1. *Theoretical Consideration*: In treating as a moderator variable, the researcher learns how it interacts with the independent variable to produce differential effects on the dependent variable. In term of theoretical base researcher is working and in term of what he is trying to find out in a particular experiment, certain variables highly qualify as the moderator variables. In choosing a moderator variable a researcher should ask: Is the variable related to the theory with which I am working? How helpful would it be to know if an interaction exists? How likely is there to be an interaction?
2. *Design Consideration*: The questions which relate to the experimenta1 design which has been chosen and its adequacy for controlling for sources of bias, the researcher should ask the following question:

   Have my decision about moderator and control variables met the requirements of experimental design in terms of dealing with the source of validity?
3. *Practical Consideration*: A researcher can only study so many variables at one time. There are limits to human and financial resources and the dead lines he can meet. By their nature some variables are harder to study than to neutralize, while others are as easily studied as neutralized. In dealing with practical considerations, the researcher must ask question like the following:

How difficult is it to make a variable a moderator as opposed to a control variable? What kinds of resources are available and what kinds are required to create moderator variables?

This is highly significant one. In educational experiment researchers often have less control over the situation than design and the retied considerations might necessitate.

Operation Definitions

Immediately upon completion of the testable hypotheses a researcher should examine them and the problem in general to determine if there are any terms which may be abstract or misleading. 'If an are found particularly in the testing hypotheses, they should be defined to make them completely operational for the study being undertaken.

The necessity for operational definitions does not mean that the researcher can define a term to mean whatever he cares to make it mean, but does enable the researcher to limit the meaning of a word. Operational definition should be more specific than those used in ordinary discourse. In other words any special term which must be used in the statement of the problem may require an operational definition to ensure clarity. Particular clarification should be given terms which are used in the formulation of testable hypothesis. The term selected must be useful and make sense. Even common adjectives may be used if you adequately explain what you mean. A point to remember is that once a researcher makes a definition, he must stick to it.

Words which may need defining are those which appear ambiguous, which have confusing interpretation and which might make a difference to a person attempting to replicate the study.

The Conditions for Making Final Decision

H.H. McAshan suggests that new researcher check the following conditions for operationally defining words before making a final decision:

1. The definition decides upon must withstand subjective analysis to determine if other qualified people could look at the word involved and come to the same conclusion.
2. The reliability of each word should be checked to find out if the subjective judgements are consistent.
3. The meaning of the operationally defined words must be mutually exclusive and not synonymous with other words, terms or, expressions.
4. The definition of each word chosen must fit the material researchers intend to study.
5. The definition decides upon must include all situations of use which will be included in the course of the investigation.

An operational definition is a definition based on the observable characteristics of that which is being defined. The word 'observable' in the significant word in describing an operational definition.

There are three approaches to constructing operational definitions:

(*i*) Type A,
(*ii*) Type B, and
(*iii*) Type C.

Type 'A' Operational Definition: The 'Type A' operational definition can be constructed in terms of the operations that must be performed to cause the phenomenon or state than an object or thing. It tells what manipulation to use to induce a particular state. They are useful in defining independent variables as prescriptions carried out by the experimenter. The same variable, of course, be operationally defined by more than one type of definition but when what variable is the independent variable. It is often the most useful.

'Type B' Operational Definition: The 'Type B' operational definition can be constructed in terms of how the particular object or thing being defined operates, that is, what it does or what constitutes its dynamic properties. 'Type B' operational definitions see particularly appropriate in an educational context for describing a type of person.

Though they may be used to define other variables, Type B definitions are particularly useful for defining the dependent variable when it is to be operationally based on behaviour.

'Type C' Operational Definitions: The 'Type C' operational definition can be constructed in terms of what the object or phenomenon being defined looks like, that is, what constitute its static properties. An Intelligent student can be defined as a person who has good memory, a large vocabulary, good reasoning ability, good arithmetic, skills etc. This type of operational definitions utilize observable structural properties of the object. It describes the qualities, traits, or characteristics of people or thing. Thus, they may be used for defining any type of variable when used for defining a person's characteristics, they specify the static or internal qualities rather than his behaviour as does the 'Type B' definition. 'Type C' operational definitions often lend themselves to measurement by tests although the ability to be tested is in requisite part of the definition.

The test ability if any hypothesis depends on whether suitable operational definitions can be constructed for its variables.

ROLE OF HYPOTHESIS

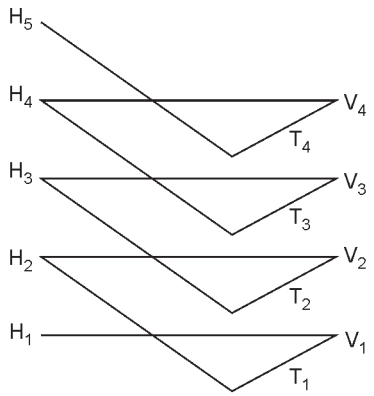
The hypothesis is the basis of a scientific investigation education. It is the pivot of the research process. All the research activities are oriented towards the verification of the hypotheses.

Apart from this role it has a significant role in the formulation of theory, principles and laws. It is also known as tentative theory, after verification it takes the shape of final theory. A theory embers new hypotheses, these are subjected to verification, after the verification it becomes a new theory in field studies. In building up the theories, this cyclic process continues. It has been illustrated with the help of a diagram.

SOURCES OF HYPOTHESES

Hypotheses are originated from essentially the same background that serves to reveal problem. These sources are namely theoretical background, knowledge, insight and imagination that comes from instructional programme and wide reading experiences, familiarity with existing practices. The major sources of hypotheses are given below:

1. Specialization of an educational field.
2. Programme of reading: Pubished studies, abstracts reearch journals. Hand books, seminars on the issue, current trends on the research area.
3. Instructional programmes pursuaded.
4. Analyse of the area studied.
5. Considering existing practices and needs.
6. Extension of the investigation.
7. Offshoots of research studies in the field.



H = Hypothesis, V = Verification
T = Theory Process for the Formulation of Theories

Process for the Formulation of Theories

Researcher employs these sources for formulating hypotheses of his investigation. He has to use two logical processes to drawn upon in developing a hypothesis. The processes are known as:

(*a*) Deductive thinking, and

(*b*) Inductive thinking.

(*a*) Deduction is a process which goes from the general to the specific : When general expectations about problems or events based on presumed relationships between variables are used to arrive at more specific expectations, that process is called deduction.

(*b*) Induction is a process which goes from the specific to the general: In the induction process researcher starts with specific observations and combines them to produce a more general statement of relationship namely a hypothesis. Many researchers begin by searching the literature for relevant specific findings in order to induce a hypothesis, and other often run a series of exploratory studies before attempting to induce a hypothesis.

Induction begins with data' and observations or empirical events and proceeds toward hypothesis and theories, while deduction begins with theories and general hypothesis and proceeds towards specific hypothesis.

FORMULATING HYPOTHESIS

From any problem statement, it is generally possible to derive more than one hypothesis. There are three simple hypotheses generated from this problem to determine, "the effect of " massive, positive, verbal rewards on the reading achievement of children."

At first glance these three hypotheses might be offered :

(A) Reward Increases reading achievement.

(B) Reward decreases reading achievement.

(C) Reward has no effect on reading achievement.

Evidence has already been obtained in the laboratory to support the hypothesis (A) rewards increase performance. However, upon closer examination, the primary purpose of this study is to

determine whether the enhancing effect of rewards can be incorporated into a class-room setting to facilitate children's learning to read. This theory is based on the assumption that the 'law' of learning should apply in classroom. If perhaps more subtly than in a laboratory and on the laboratory findings that support the assumed relationship between reward and performance, the logical conclusion would be that rewards would have a demonstrable enhancing effect on classroom performance. This conclusion is based on the first assumption arrived at deductively and the second arrived at inductively.

Both induction and deduction. are needed to choose among the possibilities. Many theories, both psychological and educational deal with stabilization (and rigidifying) of behaviour patterns as a function of their use.

Researchers formulate hypotheses using induction and deduction, one of the goals of researcher is to produce that pieces for generalizable bodies of theory which will provide answers to practical problems. Hypothesis construction and testing enable researchers to generalize their findings beyond the specific conditions which they were obtained.

Since a hypothesis is a formulation of anticipated findings, students are advised to develop a hypothesis as a means of demonstrating the basis for their study to themselves and their reader. The task of introducing a study and discussing the findings are facilitated by existence of a hypothesis.

FORMULATION OF TESTABLE HYPOTHESIS

A hypothesis is a tentative assumption drawn from knowledge and theory which is used as a guide in the investigation of other facts and theory that are as yet unknown. The hypothesis formulation is one of the most difficult and most difficult step in the entire scientific process. A poorly chosen or poorly worded hypothesis can prevent:

(*a*) the obtaining of enough pertinent data,

(*b*) the drawing of conclusions and generalizations, and

(*c*) the application of certain statistical measures in the analysis of the result.

It is impossible to over-emphasize the role of the hypothesis in research. It is the central core of study that directs the selection of the data to be gathered, the experimental design, the statistical analysis, and the conclusions drawn from the study.

A study may be devoted to the testing of one major hypothesis, a number of subsidiary hypotheses, or both major and subsidiary hypotheses. When several hypotheses are used, each should be stated separately in order to anticipate the type of analysis required and in order to definitely accept or reject each hypothesis on its own merit. Regardless of the number or type of hypotheses used, it is extremely important that each be specific testable, and based upon a logical foundation. Hildreth Hoke McAshan says only one possible exception to the above statements, which is that when fact finding alone is the primary aim of the study, it may not always be necessary to formulate an explicit hypothesis. However, this need not be a concern of most scientific researchers.

FUNDAMENTAL BASES OF HYPOTHESIS

The researcher deals with reality on two levels,

(*a*) The operational level, and

(*b*) Conceptual level.

On the operational level researcher must define events in observable terms in order to operate with the reality necessary to do researches.

On the conceptual level he must define events in terms of underlying communality (usually causal) with other events. Defining at a conceptual level, the researcher can abstract from single specific instance to general dues and thus, begin to understand how phenomena operate and variables interrelate. The formulation of an hypothesis very frequently requires going from the operational or concrete level to the conceptual or abstract level. It is this movement to the conceptual level which enables that the result to be generalized beyond the specific conditions of a particular study and thus to be of wider applicability.

Research requires the ability to move from the operational to the conceptual level and vice-versa. This ability is required not only in constructing experiments but in applying their findings as well.

Consider a hypothetical study in which programmed instruction is being compared to traditional instruction. The term 'Programmed Instruction" and "Traditional Instruction" are operational terms. These operational terms should be examined for underlying conceptual similarities and differences. This process of making conceptual contrasts between operational programme is called conceptualization or dimentionalization.

Dimensions useful for contrasting programmed and traditional instruction might be degree of feedback, rate of positive reinforcement, uniqueness of presentation format, control of pacing size of instructional units and degree of incorporation of student performance feedback in instructional design.

These six dimensions or concepts could be used for classifying any instructional model as a basis for understanding its relation to other models.

Such classification at this abstract level would help one not only hypothesize whether instructional 'model A' will be more effective than 'model B' on certain specific criteria, but to begin to understand why 'model B' is better and thus to be able to build 'model A' into other instructional procedures.

Moving from the operational to the conceptual level and vice-versa is a critical ingredient of the research to demonstration process.

Difficulties in the Formation of Useful Hypothesis: The following are the difficulties in the formation of hypothesis:

1. Absence of knowledge of a clear theoretical framework.
2. Lack of ability to make use of the theoretical framework logically.
3. Lack of acquaintance with available research technique resulting in failure to be able to phrase the hypothesis properly.

Testing the Hypothesis

The evidence of the work of hypothesis lies in its abilities to meet test of its validity. The purpose of testing a hypothesis is to determine the probability that it is supported by fact. Because a hypothesis is a general expectation about the relationship between variables there is an extremely large number of instances under which it can be tested, and it would be impractical to attempt to gain support in all of these instances. Validity of a hypothesis is established in two stages:

1. The statement of hypothesis allows the investigator to develop deduction and certain implications which when stated in operational terms can lead to rejection of hypothesis that are in conflict with accepted knowledge at the logical level.

   For example a hypothesis which says, for instance, that nondirective teachers are more effective than directive teachers would have to be tested for many groups of teachers, in

many subjects and many settings, and with many criteria before it could be accepted. If, on the basis of limited testing the hypothesis fails to yield confirming results, then it would be fair to reject it.

2. If a hypothesis passes the test of logic, it then must be subjected to an empirical test, perhaps through an experiment or a series of measurement. The hypothesis that boys are stronger or taller than girls, for example, can be verified through measurements.

A hypothesis is never proved it is merely sustained or rejected. If it fails to meet the test of its validity, it must be modified or rejected.

The confirmation of a hypothesis, on the other hand, is always, tentative and relative, subject to later revision and even rejection as further evidence appears or as more adequate hypotheses are introduced.

The form of the hypotheses to be tested can be very controversial. The null form' is probably preferred by most experienced research personnel. The null hypothesis states that there is no difference between two groups or treatments. It is generally used to spell out what would be the case if the null hypotheses were true. The no difference statement assumes that the two groups will be tested and found to be equal.

FORMAL CONDITIONS FOR TESTING HYPOTHESES

There are two types of hypothesis statements:

(*a*) Null hypothesis, and

(*b*) Hypothesis prediction form.

Whether the experimenter chooses the hypothesis prediction or the null form, there are certain formal conditions which must be met in order for the hypothesis to be considered testable. These are listed below:

1. It must be stated so that deductions can be made from it and so that decisions can be reached as to whether or not it explains the facts being considered.
2. It should be worded clearly and unequivocally in operational terms. This should leave no doubt as to what action, what prediction, what quality or quantity, or who is involved ?
3. It must be capable of being refuted. There must be some comparisons possible which will allow the researcher to give either a 'yes' or 'no' answer to the hypothesis stated.
4. It should be specific and testable, with all predictions and operations to be tested spelled out.
5. It should have simplicity. If it is too complex, consideration should be given to dividing it into sub-hypothesis.
6. It should be directly related to the empirical phenomena.
7. It must be stated in final form early in the experiment before any attempt at verification is made.
8. It should be so designed that its test will provide an answer to the original problem which forms the primary purpose of the investigation.
9. It must be related to available techniques of design procedure, and statistical analysis.
10. It should be related to available knowledge or theory concerning the original problem area.

The statement of the problem, review of literature, and other planning of early stages of a project are largely performed so as to enable the researcher to arrive at good, clearly stated, testable hypothesis.

CRITERIA FOR EVALUATING HYPOTHESIS

Some hypotheses are considered more satisfactory than others. The following are the serious considerations of a satisfactory hypothesis and these criteria may be helpful to make this judgement.

1. **Plausibility of Explanation:** Several criteria are involved in establishing the plausibility of explanations. A satisfactory hypothesis should have relevant and logical possibility about the relationship of variables included in them.
2. **Testability of Explanation:** The variables should be defined operationally and the predicted relations among them can be tested empirically. The variables of the hypothesis should be measurable or quantifiable. The suitable measuring instrument is available or it can be considered easily.
3. **Adequacy of Scope:** The most useful hypotheses explain all the facts that are relevant to the phenomena being explained and contradict none of them. The broader the scope of a theory, the more valuable it is. The more consequences that a hypothesis yields, the greater is its fruitfulness.

   A hypothesis is of greater value if it establishes a generalization that can be applied in many areas of education or in many fields.

   The most satisfactory hypotheses not only explain all the known facts that gave rise to the original problems but also enable scientists to make predictions about as yet unobserved events and relationships.
4. **Usefulness of False Hypotheses:** Hypotheses need not be the correct answers to problems to be useful. In almost every inquiry a scholar formulates several hypotheses and hopes that one will provide a satisfactory solution to the problem. By eliminating the false hypotheses one by one the investigator keeps narrowing the field in which the answer must lie. The testing of false hypotheses is also of value if it directs the attention of scientists to unsuspected facts or relations they eventually help in solving the problem.
5. **Roots in Existing Theories:** A useful educational hypothesis, therefore, adds something to previously established knowledge by supporting, qualifying, refuting or enlarging upon existing theories. A hypothesis that is compatible with well-attested theories is in a favourable position to advance knowledge. If progress is to be made new hypotheses must fit into the framework of existing theories and transform them into more perfect explanatory schemes. Thus, even the more revolutionary theories are not completely different from the existing edifice of knowledge.
6. **Suitability for Intended Purpose:** Each hypothesis that offers a satisfactory explanation of what it intends to explain is useful for that purpose. Every hypothesis serves a specific purpose and must be adequate for the purpose it claims to serve. Thus, suitability is also the important criterion for an effective hypothesis.
7. **Simplicity of Explanation:** If two hypotheses are capable to explain the same facts, the simpler one is the better hypothesis. Simplicity means that the hypothesis explains the phenomena with the least complexes theoretical structure. The hypothesis that accounts for all facts with the fewest independent or special assumptions and complexities is always preferable.

8. **Levels of Explanation:** The value of hypothesis can best be comprehended by tracing their relationship to facts theories and laws. The scientists build gradually a hierarchy of knowledge consisting of (1) hypotheses (2) theories and (3) laws. The following discussion will distinguish among these levels of knowledge.
   (*a*) *Hypotheses and Facts*: A hypothesis is the first step in the direction of scientific truth. In the hierarchy of scientific knowledge it is the lowest on the scale. If empirical evidence can be found to verify the hypothesis, it gains the status of a fact. Thus, a fact is the verified hypothesis.
   (*b*) *Hypotheses and Theories*: A theory may contain several logically interrelated hypotheses and postulates may be used as a synonyms for hypotheses. Hypotheses and theories are both conceptual in nature. A theory usually provides a higher level explanation than a hypothesis. A theory presents a comprehensive conceptual scheme that may involve several related hypotheses and explain diverse phenomena, considerable empirical evidences are needed to support it.
   (*c*) *Hypotheses and Laws*: Some hypotheses receive sufficient confirmation to lead to the formulation of theories; some lead to the establishment of laws. Laws utilize highly abstract concepts, for they provide the most comprehensive type of explanations. Laws may explain phenomena that have been explained previously by two or three theories. A law retains its lofty scientific status which it claims to explain.

THE ROLE OF HYPOTHESES

The hypotheses play significant role in the scientific studies. The following are some of the important role of a hypothesis

- The purpose of stating hypothesis, like the purpose of theories that may be involved, is to provide a framework for the research procedure and methodology. It directs the research activities.
- A research project need to proceed from a statement of hypotheses. Such hypotheses are not ends in themselves but rather aids to the research process.
- A hypothesis takes on some characteristics of a theory which is usually considered as a larger set of generalization about a certain phenomenon.
- The verification. of a hypothesis does not prove or disprove it; it merely sustains or refutes the hypotheses.
- The hypotheses may imply research procedures to be used and necessary data to be organized.
- Such hypotheses are not ends in themselves but rather aids to the research process.
- The conclusions of the research problem may also be stated in the context of the initial hypotheses.
- The stating a hypotheses in experimental research provide the basis for designing the experiment and collecting evidences empirically for its verification so as to formulate new theory in field of education.
- The hypothesis orients the research process for its verification rather than finding out the solution of the problem.

OBJECTIONS AGAINST STATING HYPOTHESES

The following objections are raised against stating hypotheses which are directional in nature

- One is that hypotheses bias the researcher in favour of certain conclusions or retain the hypotheses.
- Another is that in his pursuit of the stating hypothesis the researcher may overlook other possibly worthwhile hypotheses.
- The statement of hypotheses in some situations also may appear premature.
- A directional hypothesis needs some theoretical rationale but in some situations there is very little background information about them.
- The researcher may decide to defer any hypothesis or theories until he has some empirical evidence upon which is to base them.
- The hypotheses are stated in vacuum. These should be concerned with a situation in which it can be experienced.
- The directional hypotheses should be so stated as to reveal the role of variables involved in the investigation.

The overall consensus is in favour of stating hypotheses whenever they are feasible. In view of the above objections. researchers prefer to formulate the non-directional hypotheses these days.

HYPOTHESES IN HISTORICAL RESEARCH

The historical researcher uses his information to describe and interpret conditions, events and phenomena that existed during the period under study. Some of the scholars of research methodology are of this view that the historical researcher also can formulate hypotheses to direct the research activities. These hypotheses are attempts at explaining and interpreting the phenomena of the period under the study.

There is difference between scientific hypotheses and historical hypotheses. Hypotheses in historical research are not formulated in a statistical sense or null hypothesis. Historical hypothesis takes on a broader meaning as a conjecture of the situation.

An example, a researcher is pursuing historical research on the development of teacher-education of the secondary stage in India. There would be several hypotheses. One hypothesis may be- 'The development of teacher-education as an outgrowth of secondary schools and inadequate supply of teachers produced by the colleges'. This hypothesis is based on the assumption that there has been development of teacher-education. If this assumption was not correct, the hypothesis would have no basis. The matter of basing hypotheses on accurate assumptions may seem obvious, but failure to do so is not unknown. The position of hypothesis is based on the assumption.

USES OF HYPOTHESES IN EDUCATIONAL RESEARCHES

The educational researches may be classified into four types:

1. Experimental research,
2. Normative survey research,
3. Historical research, and
4. Complex casual research.

1. Hypotheses are indispensable for experimental researches. The experiments are conducted to collect empirical data to verify hypotheses. The experimental method or experimental designs are based on hypotheses. Hypotheses are the crucial aspects of such researches.
2. In normative survey research the investigator may or may not employ hypothetical type thinking, depending upon the purpose of the research study. Hypotheses are essential for analytical studies and there is little scope in descriptive type studies.
3. In historical research the purpose may be either to produce a faithful record of the past events irrespective of present day problem or to extend the experience with phenomena in the present to past in order to make the view of the phenomena. There is a little scope of hypotheses in historical research because hypothesis has the future reference and its verification on empirical data. Case study method has no scope for constructing hypotheses because it is developmental type study.
4. In complex casual research the hypotheses have important role in such investigations. These types of studies are conceptual in nature whereas historical are more factual in nature. Therefore formulation of hypothesis is a crucial step of this type of studies.

EXERCISES

1. Define the term 'Hypothesis'. Differentiate among assumption, postulate and hypothesis.
2. Explain the nature and functions of a hypothesis in a research process.
3. Enumerate the significance and importance of hypotheses in scientific research.
4. There are various kinds of hypotheses. Mention some important hypotheses. Why researchers prefer non-directional hypotheses?
5. Hypothesis is a statement which involves a relationship of variable. Enumerate the types of variables included in stating a hypothesis.
6. Differentiate between research hypotheses and null hypotheses and illustrate your answer with suitable example.
7. Indicate the main characteristics of a good hypothesis and uses of a hypothesis in various types of research studies.
8. Enumerate the criteria for evaluating a hypothesis and role of a hypothesis.
9. "Historical researches may have hypotheses but these are different from the hypotheses of scientific researchers". Comment on this statement.

Chapter 5

Research Planning and Sampling

The third step of any social studies research is to prepare a research design. Research design is a mapping strategy which is based on sampling technique. It essentially includes objectives, sampling, research strategy, tools and techniques for collecting the evidences, analysing the data and reporting the findings. Thus, research design is the statement of the object of the inquiry and how a satisfactory culmination to be effected. A research design is the work before getting the project underway.

MEANING OF RESEARCH PLAN/DESIGN

Research design is a choice of an investigator about the components of his project and development of certain components of the design. A design of research does not consists of an ordered sequential step-by-step procedure. It is a planning stage of research which is usually made logically visualizing its practicability. The selection of research components is done keeping in view of the objectives of the research. Research hypotheses also provide the basis for designing a research work. A research design includes the following components :

(*a*) Research method or research strategy.
(*b*) Sampling design.
(*c*) Choice of research tools, and
(*d*) Choice of statistical techniques.

A design of research is good or not, it is judged by standards such as the degree of accuracy attainable on the level of relevant evidence sought. A distinction should be drawn between statistical significance and substantive significance and appropriately applied. Above all, a good research design must be practical.

The review of the literature and related research reports are set as an important component of design. Also the classification and development of the classes of inquiry and their models are offered as major aspects of research design. Designing of research may be described as a mapping, because the research design components tend to fit into three distinct but interrelated parts; it is convenient to discuss the design components within these three components.

Kerlinger asserts that research design has two basic purposes: (1) to provide answers to research questions, and (2) to control the variance.

A research design components and proposals should give an adequate attention to each appropriate and applicable design component.

DEFINITION OF RESEARCH PLAN/DESIGN

Reduced to the simplest of terms, “research design is a mapping strategy. It is essentially a statement of the object of the inquiry and the strategies for collecting the evidences, analysing the evidences and reporting the findings.”

It should be made clear that the design components are in part mandatory and in part choices made by the researcher. Just as the object of the inquiry often determines the class of inquiry or model to be utilised, so too, does the model or class of inquiry determine the consideration and development of certain of the design components. In fact, it is essentially the variation in some of the design-components that differentiates among the classes of inquiry.

DESIGN FORMAT FOR A RESEARCH PROPOSAL

Title

I. Problem Statement and its clarifying components.
   (A) Statement of the problem.
   (B) Clarification of the problem statement:
      1. Definitions.
      2. Delimitations.
      3. Assumptions.
      4. Theory base.

II. Group Components for Operation
   (A) Hypothesis/Question design.
   (B) Sample population-sample or group at hand design:
      1. Population delineated, delimited and defined.
      2. Sample delineated, delimited and defined.
      3. Group at hand delineated, delimited and defined.
   (C) Observation Design:
      1. Data (evidences) Collection
      2. Instrumentation:
         (*a*) Questionnaire.
         (*b*) Schedule.
         (*c*) Sources
         (*d*) Standard measures.
   (D) Statistical Designs:
      1. Descriptive statistical design
      2. Inferential statistics for generalization design.
      3. Statistical randomization procedures for control design.
      4. Computer assistance design.
   (E) Organizational Design.

III. Significance and Review Sections:
   (A) Significance of the objectives of the Inquiry.
   (B) Review of the Related Literature and Research Reports.

The object is to test the relationships indicated in the hypotheses in such a manner that the researcher will be able to either accept or reject the hypotheses. To accomplish this a basic design must

be established which will (1) allow the researcher to control the different variables and (2) ensure that the controlled treatments are comparable.

CHARACTERISTICS OF GOOD RESEARCH DESIGN

In a general sense we could answer the question (what makes for good research design)? With such statements as the design should be appropriate for the hypotheses or the design should be feasible within the limits of available resources. The following are the specific characteristics of a good research design:

1. It should be free from bias or learnings.
2. It should be free from confounding effect. A good research design eliminates confounding of variables or kept it to a minimum so the results can be interpreted separately. There should be a statistical precision. The hypotheses can be tested by employing most appropriate statistical technique.

There should be enough scope to impose the control over the situation. There are basically four ways by which control can be enhanced :

(*a*) Through the method of Randomization.
(*b*) Holding conditions or factors constant.
(*c*) Building conditions or factors into the design as independent variables.
(*d*) Statistical adjustment.

POTENTIAL PROBLEMS IN RESEARCH DESIGN

There are several difficulties which make poor research design:

1. Inadequately stating and testing hypotheses.
2. Missing or unusable data.
3. Bias in sampling.
4. Inadequate measurement.
5. Lack of precision in statistical technique or inappropriate statistical devices.

Research Methodology

Research methodology involves the systematic procedures by which the researcher starts from the initial identification of the problem to its final conclusions. The role of the methodology is to carry on the research work in a scientific, and valid manner. The method of research provides the tools and techniques by which the research problem is attacked. The methodology consists of procedures and techniques for conducting a study. Research procedures are of little value unless they are used properly. The tools and techniques will not get the work done. The proper use of research method must be learned by the researcher.

Research methodology involves such general activities as identifying problems, review of the literature, formulating hypotheses, procedure for testing hypotheses, measurement, data collection analysis of data, interpreting results and drawing conclusions. Thus, research methodology consists of all general and specific activities of research. Mastery of the research methodology invariably enhances understanding of the research activities. Thus, it seems that research design and methodology have the same meaning i.e. mapping strategy of research.

SUITABILITY IN SHAPING METHODOLOGY OF EDUCATIONAL RESEARCH

Webster has defined methodology as "the science of method or arrangement" which is not a particularly useful definition. Method is defined as orderliness and regularly or habitual practice of them in action." By placing stress on 'arrangement', orderliness regularity and habitual practice. the methodologies derive their substance essentially from the classically ideal controlled experiment which permeates rightly or otherwise. in the literature of educational research. The methodology means with reference to research that it is a type of inquiry.

Suitability as a criterion for consideration of a type of inquiry is much like that of utility but suitability of educational research methodology requires two conditions:

- internal validity (control), and
- external validity (sampling).

Kish referred to internal validity as control and to external validity as representation of sample. Thus, internal validity (control) is the condition which permits blaming the independent information variable for the findings or being certain that the observation was produced by the information variable. External validity (sampling or representation) is a condition permitting the generalization or inference for the findings to the population from which the sample was drawn.

The Crucial Issue of Social Studies Research Design: It is difficult to design a research project that meets both of these conditions. The classical ideal controlled experiment is endowed with both of these attributes. However, in education the controlled experiment will tend to be strong on internal validity and less strong on representation (external validity). There is visually no claim to external validity in more control observation.

At this risk of over simplification, the investigation may be described as possessing less control concern than does the study and even less of a claim to external validity. The choice of this type of inquiry depends, in part, on the attainability of control and/or representation with a given research project and in part, on the relative need for control and/or representativeness.

The other type of inquiry is 'action research'. Control or internal validity and representativeness or external validity are desirable conditions. However, 'action research' is an adhoc methodology and the conditions of control and/or representativeness are special applications. Thus, they are discussed as they are individually applied.

Internal Validity

The world we know is composed of variables. A variable is described as a thing subject to change or fluctuation. Research is a process by which knowledge is either increased or clarified and progress is stimulated towards man's need for problem solving. But problem solving and understanding derive from control or knowing the effect of a particular variable on other variables.

Internal Validity derives from the control of variables. Control variable or constant is frequently added to the set or substitution for the development variable. A most common set of variables consists of dependent, independent and intervening variables. The use of independent variable to describe the variable to be manipulated and dependent variable to describe the other part of the relationship is frequently erroneously applied to a given research inquiry.

Information variables: All the independent variables are information variables. An information variable is the treatment applied to a group of subjects to discern the effect it has on the group characteristic.

The information variable is the treatment applied to a group of subjects to discern the effect it has on the group under the conditions imposed. The experimental variable and control variable are information variables.

Confounding Variable: The intervening variables are confounding variables. A confounding variable is one which, if not controlled or held constant between groups, will cloud the certainly about the effect the information variable has on the group characteristics- the dependent variables identified as relevant confounding variables having to be controlled in the given inquiry. The dependent variable is the constant.

Relevant confounding variables may also lie the subjects. Sometimes these variables are overlooked because they are not apparent.

Internal validity is accomplished to some extent by selection or control of the relevant confounding variables. It is essentially a procedure of matching the subjects on the basis of the confounding variables.

Randomization is another procedure in the attempt to attain satisfactory or acceptable internal validity. It should be noted that statistical randomization does neither eliminate nor control the confounding variables.

External Validity

External validity (sampling for representation) is the condition permitting the generalization or inference of the sample findings to the population from which the sample was selected.

Representation is a desirable condition in the experiment and especially demanding condition in the survey research.

As the likelihood of representation (external validity) increases through sampling procedures. the certainty of internal validity (control) decreases. Because findings derived from samples are subject to error, procedures such as sampling-error statistics are used for estimating the accuracy of the sampling-findings. A sampling error is the difference between the true measure of the population (parameters) and an estimate of that parameter which is the sample-finding or observed measure. The degree of external validity is reported as level of confidence at .01, .0, level of significance.

The .01 level means that if other samples were drawn from the same population, the likelihood of obtaining a comparable sample finding is 99 in 100 samples.

MEANING AND DEFINITION OF SAMPLING

Sampling is indispensable technique of behavioural research, the research work cannot be undertaken without use of sampling. The study of the total population is not possible and it is also impracticable. The practical limitation: cost, time and other factors which are usually operative in the situation, stand in the way of studying the total population. The concept of sampling has been introduced with a view to making the research findings economical and accurate.

The research design is based on the sampling of the study. A good research design provides information concerning with the selection of the sample population treatments and controls to be imposed.

Generalizability of the research findings is, of course, dependent upon the sampling procedures followed. An ideally either a representative or random sample would be desirable to provide maximum information about the generalizability of research data.

W.G. Cocharn defined the term sampling

"In every branch of science we lack the resources, to study more than a fragment of the phenomena that might advance our knowledge."

In this definition a 'fragment' is the sample and 'phenomena' is the 'population'. The sample observations are applied to the phenomena i.e. generalization.

'Sampling design' in fact means the joint procedure of selection and estimation. Sampling should be such that error of estimation is minimum.

"In the social sciences, it is not possible to collect data from every respondent relevant to our study but only from some fractional part of the respondents. The process of selecting the fractional part is called sampling."

– David S. Fox

Sampling is fundamental to all statistical methodology of behavioural and social research. Bad sampling vitiates the data at the source and no amount of subsequent statistical findings will improve its quality. In fact sampling is the part of the strategy of research and has by now acquired the status of technical job.

In physical sciences there is a no problem of sampling, any fragment or piece of a phenomena is the true representative, therefore, the generalization based on the sample is true. But in behavioural and social sciences sampling is the crucial problem to have a representative sample. Sampling means, selection of individuals from the population in such a way that every individual has the equal chance to be taken into the sample population.

Population or universe means, the entire mass of observations, which is the parent group from which a sample is to be formed. The sample observations provide only an estimate of the population characteristics.

The term 'population' or universe conveys a different meaning than a traditional one. In census survey, the count of individuals (men, women and children) is known as population. But in research methodology population means the characteristics of a specific group. For example, secondary teachers of Uttar Pradesh, who have some specific features (teaching experience, male and female, academic qualification. teaching attitudes, teaching aptitude etc.). Another example, high school students of Rajasthan who have some specific characteristics (age group), boys and girls personality, scholastic aptitude, academic motivation etc.).Thus, secondary teachers from one population and high students from another populations, they have different characteristics.

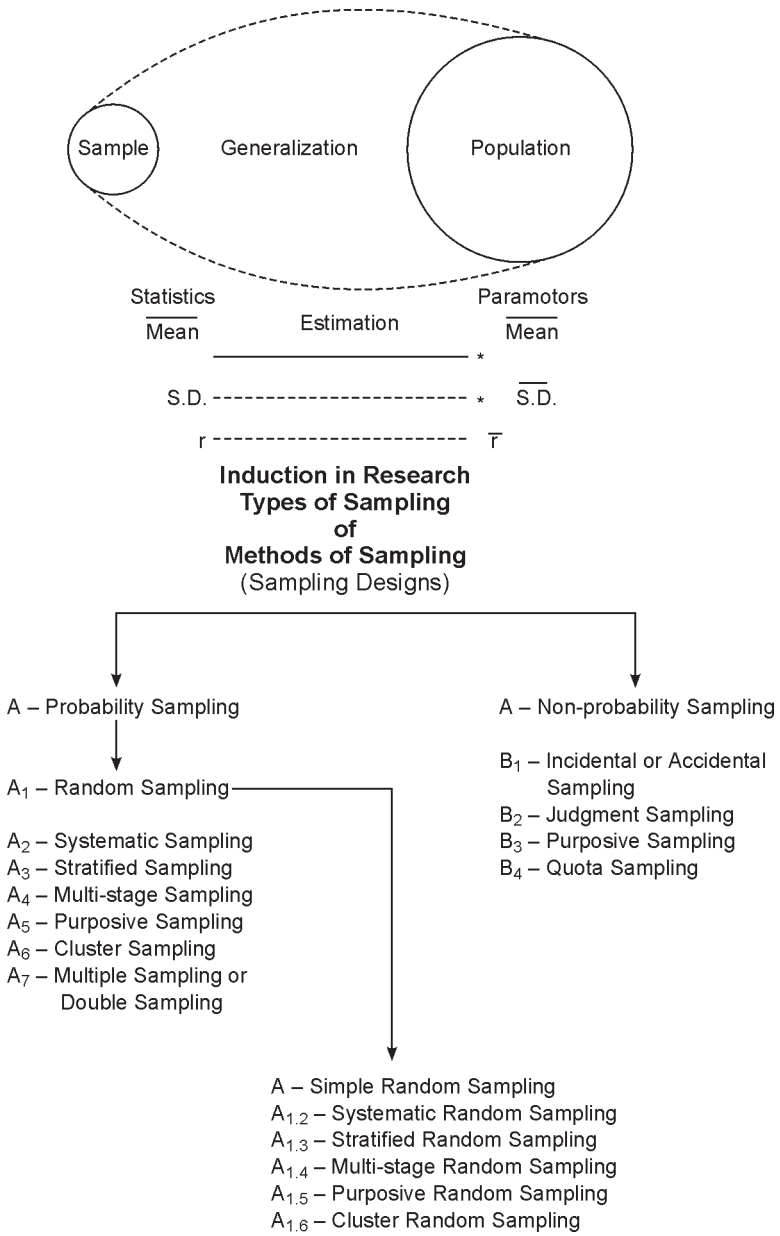
In selecting a sample subjects it is very essential that researcher should define his population and enumerate its characteristics.

FUNCTIONS OF POPULATION AND SAMPLING

Research work is guided by inductive thinking. The researcher proceeds from specificity to generality. The sample observation is the specific situation, which are applied to the population, it is the general situation.

The sampling is the fundamental to all the statistical techniques and statistical analysis. The measures of a sample are known as statistics and measures of a population are termed as parameters. Mean, Standard deviation and Coefficient of Correlation of sample observations are known statistics and Mean S.D. and Coefficient of Correlation of a population are called parameters. Generally parameters are estimated on the basis of sample statistics. The accuracy of the parameters depends on sample

representativeness or statistics. In research work generalization is made by estimating parameters on the basis of sample statistics.



RANDOMIZATION

Randomization is a method of sampling in which each individual of the population has the equal chance or probability of selection of the individuals for constituting a sample. The choice of one individual is in no way tied with other. The individuals of a sample are independently drawn from the population. All members of the population have essentially the same probability of being selected. The following are the main characteristics of randomization:

1. Each individual of the population has equal chance of being picked up into the sample.
2. One individual does not effect in selection of the other. There is no tie with one another.
3. It is free from subjective factor or personal error or bias and prejudices or imagination of the investigator.
4. It ensures that the sample formed by this method. may be representative of the population.

Methods of Randomization

The following are main methods of randomization:

(*a*) Lottery method of randomization.
(*b*) Tossing a coin (Head or tail) method.
(*c*) Throwing a dice.
(*d*) Blind folded method.
(*e*) Random tables (Tiptt's Table of Randomization).

The randomization can be done by employing either of the methods for selecting sample subjects from the population. Generally random tables are used for constituting a sample in educational research.

Advantages of Randomization

The following are the major advantages of randomization:

1. It is an objective method of sampling.
2. It is an economical method from money, energy point of view.
3. It is a convenient approach of sampling in the field of research.
4. It permits the application of statistical devices and treatments of data. The error due sampling can be estimated.
5. It maintains the accuracy in the analysis of results.
6. It is a practical method of sampling.
7. A representative sampling may be selected by using randomization.

Limitation of Randomization

The following are the main limitations of this method :

Randomization does not ensure the representativeness of population. A random sample may be good representative or may not be. There is no guarantee for representativness of the population by the method.

If randomization is not done rigorously, it may allow for personal areas or subjectivity.

Actual randomization involves some practical operations, if the situations are not favourable the process of randomization might be effected.

The method of randomization can not be used effectively in educational research, because principles, heads can not permit to select subjects randomly from a class or an institution. Thus, selected subject may not co-operate.

TYPES OF SAMPLING DESIGNS

Several methods 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. **G.C. Halmstadter:** A Probability sample is one that has been selected in such a way that every element chosen has a known probability of being included. Generally probability sampling is used in Fundamental Research (F.R.) since in F.R. our purpose is to generalize the results.

There are two laws of probability sampling:

(1) Law of Statistical Regularity, and (2) Law of Inertia of Large Sample.

1. **Law of Statistical Regularity:** This law involves the probability principle. A small sample may be good representative of the population, if the subjects of sample are selected at random. The conclusions drawn from the sample may be generalized for the population. The sample 'statistics' are the estimates of the population parameters. The parametric test of significance can be used for this purpose.
2. **Law of Inertia of the Large Sample:** It is the corollary of the first law. A large sample is more stable or good representative as compared with small sample. The sample error is inversely in proportion to the size of sample. It can be shown with the help of the following formula:

$$SE_M = \frac{\sigma}{\sqrt{N}}$$

If N size of the sample increases the sampling error or standard error the mean decrease. If it tends to infinity, the sampling error will be zero.

$$SE_M = \frac{\sigma}{\sqrt{\alpha}} = 0$$

Therefore, parametric tests are used for inferential purpose.

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. Aandomization 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 informations 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 not proportionate to the size of the unit but depends upon considerations involving personal judgement 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 Str. Sampling*	*Proportionate str. Sampling*	*Optimum allocation 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 analysed, 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.

7. 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 behavioural 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. Judgement 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 upon the 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 utilise the inferential parametric statistics.
(*e*) Inability to make generalization concerning total population.

4. Quota Sampling

This combined both judgement sampling and probability sampling. The population is classified into several categories: on the basis of judgement 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 judgement 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 pre-conception, 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.

Advantages of Sampling Technique according to R.A. Fisher

Fisher has enumerated the following four advantages of sampling technique:

1. It has a greater adaptability.
2. It is an economical technique.
3. It has high speed for generalization.
4. It has a greater precision and accuracy in the observation.

Advantages of Sampling Technique according to W.G. Cocharan. He has given the following four advantages of sampling technique:

1. This technique has great accuracy.
2. It has a greater speed in conducting a research work.
3. It has a greater scope in the field of research.
4. It reduces the cost of observation or data collection.

Types of Errors in Sampling

The samples of behavioural research are not representative and suffer from two types of errors:

(1) Random error, and (2) Systematic error.

These errors can be classified further as :

(*a*) Sampling errors and (*b*) Error of measurement.

Thus, it provides a four-ways classification and has been shown in following manner:

	Random	Constant
Sampling measurement	A	B
	C	D

Cell A refers to the unavoidable errors that occur whenever sampling is done. The sample selected at random may be high, low or average with regard to the trait measured. This error can be minimized by selecting a large sample.

Cell B refers to errors of bias in sampling, i.e. sampling errors which do not cancel out, but rather lean systematically in one or the other direction of the population value. This error is due to any decision of researcher for selecting subjects for the sample. The systematic error exists, the data are of limited use as the basis for generalizing to the population. Thus, Cells A and B refer to the errors and sampling.

Cells C and D refer to errors. In the process of measurement, rather than to errors in sampling. The errors in Cell C which occur from the simple fact measurement derived from any instrument of less than complete reliability are inevitable in some degree of error. The error of measurement is cancelled out by selecting a large sample. Sum of errors of measurement is always zero.

Cell D concerns with another bias-that is due to systematic errors of measurement. If, in the testing of subjects for intelligence, the test administrator allows an extra three minutes for the test, there will be probably be systematic tendency for the sample statistics to be higher than the population parameters.

The systematic errors are the bad errors in both in sampling and in measurement. The magnitude of random sampling errors as they affect the sample statistics as given below:

$$SE_M = \frac{\sigma}{\sqrt{N}}$$

If greater accuracy is required, it can be obtained by increasing the size of sample or the homogeneity of the variable under-investigation or by using adequate sampling design.

If the results obtained are systematically higher or lower than the corresponding true value, the sample is biased and the discrepancy is called an error of bias.

Size of Sample

One of the first questions that the researcher typically asks, concerns with the number of subjects that need to be included in his sample. Technically, the size of the sample depends upon the precision the researcher desires in estimating the population parameter at a particular confidence level. There is no single rule that can be used to determine sample size.

The best answer to the question of size is to use as large a sample as possible. A larger sample is much more likely to be representative of the population. Furthermore with a large sample the data are likely to be more accurate and precise. It was pointed out in that the larger the sample, the smaller the standard error. In general, the standard error of a sample mean is inversely proportional to the square root of *n*. Thus, in order to double the precision of one's estimation, the sample size would need to be quadrupled.

It is often suggested that one should include at least 30 subjects in a sample since this number permits .the use of large sample statistics. Statistically speaking, a sample $n = 30$ is considered large, since with this n, the t-distribution and the normal curve are practically the same for hypothesis testing purposes. In experimental research, one should select a sample that will permit at least 30 in each group. Descriptive research typically uses larger samples; it is sometimes suggested that one should select 10-20 per cent of the accessible population for the sample.

Determine the Size of Sample: It is the crucial problem for the research scholars to determine the size of sample. In an experimental study, it is essential to equate the control and experimental groups, but in survey study sample should be representative of population. Therefore, size of sample is an important aspect for the representativeness. Mouly has suggested a statistical criterion for determining the size of the sample.

Other things being equal, the larger the sample, the greater the precision and accuracy of the data it provides. It is a common belief that the precision of data is determined primarily by the size of the sample, rather than by the percentage of the population represented in the sample. The term 'large sample' is vague, it varies with nature of study. The exact procedure by which to determine the sample size required varies with the nature of the variable and its sampling distribution, but the basic procedure can be illustrated in connection with the mean of random samples based on normal probability distribution. The chances are 95 to 5 that a sample in separated sampling will fall within the interval $M \pm 1.96\ SE_M$.

The next question is the degree of accuracy required. Generally 95 to 99 per cent confidence intervals are acceptable i.e. 5 to 1 per cent error. If the variable of the study is the intelligence and the sampling errors were kept within 5 per cent at the 95 per cent confidence level. The investigator can use the formula for the standard error of the mean to provide the required size of sample.

$$1.96\ SE_M = 5,$$

$$1.96\ \frac{\sigma}{\sqrt{n}} = 5$$

Where

σ = S.D. of the population

n = Size of the sample

5 is percent of sampling error

In this illustration I.Q. distribution $s = 16$

$$\sqrt{n} = 1.96 \times \frac{16}{5} = 9.30$$

$$n = 96$$

If the investigator wants more precise, the sampling error is kept within 1 per cent at the 99 per cent confidence level. The following formula is used for determining the size of sample:

$$2.58\ SE_M = 1\ ;\ 2.58\ \frac{\sigma}{\sqrt{n}} = 1$$

$$2.58 \times 16 = \sqrt{n}\ \sqrt{n} = 41.28$$

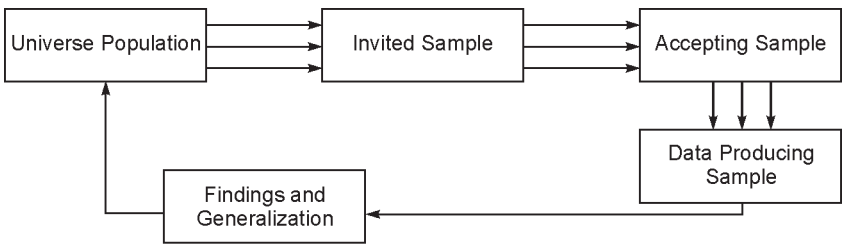
$$n = 16$$

Thus, he would need a sample of 96 case in order to meet the conditions of 5 per cent error at 95 per cent confidence level. He would require a sample 1681 case for 1 per cent error at the 99 per cent confidence level.

Generally in behavioural research more than one variable are taken into a study. In such situation he should consider standard deviations of the distributions of the variables. The highest S.D. is to be considered for calculating the size of the sample. In this way a researcher can determine the exact size of sample indicating the sampling error in per cent. He should not use an arbitrary criterion for determining the size of his sample.

THE SAMPLING CYCLE

Five stages of sampling cycle are proposed here, as sketched in figure. In this cycle, the researcher identifies the universe that is relevant for his research problem and then identifies his population, that is, that portion of the universe to which he has access. Then by applying the techniques for sample selection, he decides how large a sample he needs, selects, and invites that number to participate. To this point, the researcher has completed control over the process, but at this point the respondents assume most of the control. For now, some do and others do not accept the invitation, and so typically more invitations are extended until sufficient number accept so that the sample is of desired size. Those who do accept from the accepting sample then the researcher applied his data gathering technique to the accepting sample depending upon factors like the data gathering design, methods and techniques, all or only some of the accepting sample actually produce data. Those who do form the data producing sample, it is from these data that the researcher obtains his findings and makes his conclusions.



The Sample Cycle

REPRESENTATIVES

Completing the sample cycle by applying findings and generalization to the population and universe makes sense in one set of circumstances only, when the various samples can be considered representative of the population and universe. But as the Sample Cycle is intended to illustrate and emphasize, representativeness is a securing concern throughout the sample process. When we identify the universe of relevance for our respondents and research problem and select the population, we face the first representative question can the population be considered representative of the universe? If it can move on to identify and select the invited sample, and from this derive the accepting sample. At this stage there is second concern with representativeness of the accepting sample to the population.

When the data gathering instrument one administered and the researcher learns what kind of attribution has taken place in terms of the data producing sample which has emerged. he must face the

critical issue of determining if he can consider the data producing sample representative of the accepting sample and therefore of the population but we are using ambiguous concept at the heart of this discussion "representative". We want every stage to be representative of proceeding stage but representative in terms of age, shoe, size, sex, voting record, we could extend a list of possible human characteristics and attributes endlessly. We want representativeness in terms of these variables that are known to be related to the phenomenon under study.

IDENTIFYING A REPRESENTATIVE SAMPLE

The representative issue comes to the four first in the identification of the population within the universe. For every research problem there is one completely relevant universe, but any number of population. For example, for a study concerned with the relative teaching ability of liberal acts of graduates and school of education graduates, the obvious universe of relevance is all liberal acts and education graduates functioning as a teacher who graduates two year prior to the date at which the study will collect its data. But clearly no researcher will have access to this universe.

Next step in the sampling cycle is the identification of the invited sample at this stage we can seek to guarantee that the invited sample is representative of the population on selected characteristics. In doing so we must consider two different aspects of representativeness: (1) assuring that all significant aspects of a characteristics are represented in the sample, and (2) assuring that each aspect is of the same proportion of the sample as it is of the population.

Assuring that all significant aspects of a characteristic are represented in the sample is achieved through a process called stratification. This involves in dividing the population into sub-groups or strata on the basis of the characteristics for which we seek representativeness and creating our sample by separate selections for each stratum.

In summary, it might be repeated that there is no best sampling design. Validity of sample data, like validity of all data, is a specific concept to be evaluated from the standpoint of the specific case. It is, therefore, difficult to generalize. Nevertheless, it is generally true that the aspect of sampling to which investigators of educational problems might most profitably devote their attention is minimizing possible bias rather than devising complicated design.

RELIABILITY OF SAMPLING

There are three ways of deciding the reliability of sample:

1. By Selecting Another Parallel Sample

Results analysis for sub-sample and compare with main sample. This process establishes the reliability of the sample.

2. Statistical Technique

Reliability of the statistics also indicates the reliability of sample this can be estimated by using statistical method: method is standard error of mean-The means of randomly selected samples, which are normally distributed, have their own standard deviation, known as the standard deviation, or standard error, of the mean. The standard error of the mean of a sample is computed from the formula:

$$\sigma_M = \frac{\sigma}{\sqrt{N}}$$

where σ_M = Standard error of mean
σ = Standard deviation of the population
N = Size of the sample.

The standard error of the sample means that it has a smaller value than the standard deviation of the individual scores. This is understandable because in computing the means of Sample, extreme scores are not represented by the means which are middle scores values:

From the formula $\sigma_M = \frac{\sigma}{\sqrt{N}}$, it is apparent that as the size of the sample N approaches infinity, the mean approaches the population mean and the standard error of mean approaches zero.

$$\sigma_M = \sigma_M = \frac{\sigma}{\sqrt{N}} = 0$$

As N is reduced in size and approaches one, the standard error of the mean approaches the value of the standard deviation of the population scores.

$$\sigma_M = \frac{\sigma}{\sqrt{1}} = \sigma$$

This analysis suggests that other factors being equal statistical inferences based upon small samples have larger margins of error than those based upon larger samples. Thus, the distribution of sample means is similar to the distribution of population, *n* scores except the range of sample means and their standard deviation are smaller in value.

The value of the true mean of an infinite population is not known, for it can not be calculated. One might say that it is "known only to God:". But a particular mean calculated from a randomly selected sample can be related to the population mean in the following way:

Approximately 68 per cent of the sample means will lie within a range of $\pm \sigma_M$ of the population mean. 95 per cent of samples means will lie within $\pm 1.96\ \sigma_M$ of the population mean.

99 per cent of sample means will lie within $\pm 2.58\ \sigma_M$ of the population mean.

The mean of the samples means will approximate the population mean.

APPLICATION OF SAMPLING TECHNIQUE IN VARIOUS TYPES OF RESEARCH HISTORICAL RESEARCH

In historical research the problem of sampling is not so important because historical research is based upon past records, events and facts but in Case Study-Method judgement sample and purposive sample is used because the purpose of case study method is to improve the case and not to conclude therefore non "probability sampling is applied.

NORMATIVE SURVEY METHOD

In this method random sampling is frequently used because in normative survey large sample is selected-systematic, multi stage and multiple sampling can also be used in normative survey method.

EXPERIMENTAL METHOD

In experimental method most precise and comprehensive method of sampling is preferred. Therefore, stratified sampling technique is used but in educational situation it is often difficult to use this stratified sampling than cluster sampling technique is preferred.

In the field of education research cluster sampling techniques is most frequently used and it has some limitations but it has usability in teaching learning situations and educational research.

EXERCISES

1. What do you mean by research design? Differentiate between research methodology and research design. Illustrate your answer with suitable example.
2. Enumerate the characteristics of good research design and indicate potential problems in preparing a research design.
3. Define the term 'Sampling'. Differentiate between sample and population and illustrate your answer with examples.
4. Distinguish between probability sampling and non-probability sampling. Mention the assumptions of a probability sampling.
5. What do you mean by the term 'Randomization'? Indicate the methods of randomization and their advantages and limitations.

Chapter 6

Survey Method

Research has threefold objectives: Theoretical, factual and application. These objectives are achieved by employing different methods and strategies of research. A research scholar should know the meaning of the term method and strategy of research.

MEANING AND DEFINITION OF METHOD

Method is a style of conducting a research work which is determined by the nature of the problem. M. Verma has defined the term method in the following manner -

"Method is only in the abstract as logical entities that we can distinguish between matter and methods, in reality, they form an organic whole and matter determines method analogously as objective determines means and content and spirit determine style and form in literature."

M. Verma has presented broad meaning of the term method. According to him matter is important for determining method. The common types of matter may be three types, hence all the methods can be classified under three heads

1. Theoretical problem – survey, experimental method.
2. Factual problem – Historical, case study and genetic methods.
3. Application problem – Action Research.

Broudy (1963) stated that "Method refers to the formal structure of the sequence of acts commonly denoted by instruction. The term method covers both strategy and tactics of teaching and involves the choice of what is to be taught, and the order in which it is to be taught."

Method is more general, it includes techniques also. The research techniques are ways of implementing a method. Different techniques may be employed within the same method.

Webster defined methodology as "the science of method or arrangement" which is not a particularly useful definition. Method is defined as "orderliness and regularity or habitual practice of them in action". By placing stress on "arrangement", orderliness, regularity and habitual practice, the methodologies derive their substance essentially from the classically ideal controlled experiments which permeates rightly or otherwise, the literature of educational research. The methodology means with reference to research that it is a type of inquiry.

Definition of Strategy

The term research strategy has been defined in the following manner –

"Research strategy is a generalized plan for a problem which includes structure, desired solution in terms objectives of research and an outline of planned devices necessary to implement the strategy. The research strategy is a part of a larger development scheme of research' approach."

The term 'strategy' has been borrowed from military science. It refers to the objectives of research. The objectives of research work determine the strategy. A generalized plan for realizing the objective is known as research strategy. The research strategy is based on the objective of research, while research method is based on the nature of the research problem. The same method of research may be called as research strategy, if it is determined by considering the objective of research. In the recent literature research strategy is now being used.

THE SCIENTIFIC METHOD

The scientific method is a general set of procedures or steps through which the systematic approach is developed. The scientific method and systematic approach are synonymous. It is a more specific research process. A series of steps are used in the scientific method of research–

The initial step of the scientific method that of observing some phenomenon represents an insight into some experience. The need to resolve the problem is felt and the individual prepares to do something about the need.

The second step is to Identify the problem more precisely. It involves the formulation of hypotheses based on observed phenomenon.

The third step of the scientific method is to develop and apply a design for the solution of the problem and testing the hypotheses.

The fourth step usually identified is a continuation of the third step - that continued testing hypotheses. Results are subjected to further analyses and tests.

The final step is that of drawing conclusions based on data and" tests and integrating these conclusions with the existing body of knowledge.

Assumptions of Scientific Method

The following are the main assumptions of this method :

1. It is assumed that we are living in a real world i.e. there exists an objective reality, independent of whether or not. It has been discovered.
2. The assumption of the uniformity of nature is that what has been found to be true will continue to be true and that similarity of circumstances will produce consistently similar results. The assumption relates to the three postulates:

   (*a*) Natural kinds, (*b*) Constancy, and (*c*) Determination.

   (*a*) The postulate of natural kinds is the principle that natural phenomena can be classified according to common characteristics. We can classify student behaviour or performance e.g. divisions and grading system.

   (*b*) The postulate of constancy assumes that In nature there is a certain degree of consistency. The performances of students under certain conditions are expected to be the same as they have been in the past, given the same conditions.

(c) The postulate of determination assumes that within the orderliness of nature, the occurrence of a phenomenon is preceded by certain antecedent events or conditions.

The Use of Scientific Method

The use of scientific method rests upon these assumptions and postulates. It Is used for studying the cause-effect relationship two or more variables. It establishes the functional relationship among variables.

TYPES OF RESEARCH METHODS

George J. Mouly has classified research methods into three basic types: Survey, historical and experimental methods. The meanings and their further classification have been given in the following paras:

1. Survey Method

It is concerned with the present and attempts to determine the status of the phenomena under investigation.

This method has been further classified into four categories:

(*a*) Descriptive (*b*) Analytical (*c*) School survey and (*d*) Genetic.

(*a*) Descriptive survey is of four types:

a_1–Survey testing method,

a_2–Questionnaire survey method,

a_3–Interview survey method.

(*b*) Analytical survey is of five types:

b_1–Documentary frequency,

b_2–Observational survey,

b_3–Rating survey,

b_4–Critical incident,

b_5–Factor analysis.

(*c*) School survey and

(*d*) Genetic survey.

2. Historical Method

This method is concerned with the past and which attempts to trace the past as a means for seeing the present prospective.

The historical method can be classified into three types:

(*a*) Historical, (*b*) Legal, and (*c*) Documentary.

3. Experimental Method

It is oriented towards the discovery of basic relationship among phenomena as means of predicting and eventually, controlling their occurrence.

The experimental method has been further classified into four types as given below:

(*a*) Simple experimental designs,

(*b*) Multio-variate analysis,

(*c*) Case study, and
(*d*) Predictive or correlation.

Another way of Classification of Methods

The purpose of research work is to examine the phenomena.

It can be studied by employing either of research approach. There are two approaches of research:

1. **Longitudinal Approach:** Which is concerned with complete information of the phenomena from its genesis upto its fruit. This is the time sense approach.
   This approach employs three methods of research
   (*a*) Historical method,
   (*b*) Genetic method, and
   (*c*) Case study method.
2. **Cross-sectional Approach:** Which is concerned with the information of any aspect of the phenomena in the existing situation.
   This approach employs the following three methods
   (*a*) Survey method,
   (*b*) Experimental method, and
   (*c*) Casual comparative method or Ex-post facts method.

NORMATIVE SURVEY METHOD

The word 'survey' has been derived from the words 'sur' or 'sor' and 'veeir' or 'veior' which means 'over' and 'see' respectively. Normative survey deals with ''what is" ? Its scope is very vast. It describes and interprets what exists at present. In a normative survey we are concerned with conditions or relationships that exist, practices that prevail, beliefs, points of view or attitudes that are held, processes that are going on, influences that are being felt, and trends that are developing.

Writers have used various terms like 'Normative', 'descriptive', 'survey', 'status' or 'trend' to describe such type of investigations.

PURPOSE AND USES OF SURVEY METHOD

The following are the main purposes and uses of survey methods of research:

Although the major purpose of survey method in research is to tell ''what is"? i.e., to describe the problem or phenomenon, but many surveys go beyond a mere description of the existing situation. For example, the survey dealing with curriculum courses help us in obtaining information not only about the strength and weaknesses of the current curriculum but also can elicit recommendations for change.

Descriptive surveys, or normative surveys are often carried out as preliminary step to be followed by researcher employing more vigorous control and more objective methods.

Descriptive surveys or studies also serve as direct sources of valuable knowledge concerning human behaviour.

Descriptive studies are helpful for us in planning various educational programmes, school census, in perhaps, the most universal application of the descriptive method to educational planning, school surveys are conducted to help, solve the problems of various aspects of school i.e. school plants, school maintenance, teaching staff, curriculum, teaching methods, learning objectives and the like.

3. Informations which the Survey Methods Collect

The survey methods of survey studies collect the following three types of informations

The informations are:

(*i*) of what exists,

(*ii*) of what we want, and

(*iii*) of how to get there.

The information of what exists is gathered by studying and analyzing important aspects of present situation.

The information of what we want, is obtained by clarifying goods, goals, and objectives possibly through a study of the conditions existing else where or what experts consider to be desirable.

The Information of how to get these are collected through discovering the possible means of achieving the goals on the basis of the experiences of others or of opinions of experts.

4. Characteristics of the Survey Method

The following are the main characteristics of the survey method of research:

1. The survey method gathers data from a relatively large number of cases at a particular time.
2. It is essentially cross-sectional.
3. It is not concerned with the characteristics of individuals.
4. It involves clearly defined problem.
5. It requires experts imaginative planning.
6. It Involves definite objectives.
7. It requires careful analysis and interpretation of the data gathered.
8. It requires logical and skilful reporting of the findings.
9. Surveys vary greatly in complexity.
10. It does not seek to develop an organised body of scientific principles.
11. It provides information ‘useful to the solution of local problems.
12. It contributes to the advancement of knowledge because affords penetrating insight into the nature of what one is dealing with.
13. It suggests the course of future developments.
14. It determines the present trends and solves current problems.
15. It helps in fashioning many tools with which we do the research.

TYPES OF SURVEY STUDIES

There are three criteria for classifying the survey research:

(*a*) Nature of variables

a_1 – Status survey

a_2 – Survey research

(*b*) Group Measured

b_1 – Sample

b_2 – Population

(*c*) Sources of data collection

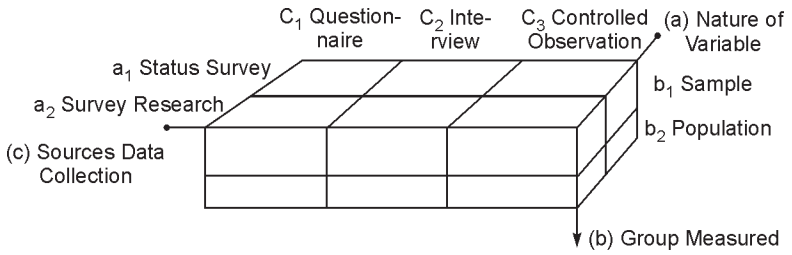
c_1 – Questionnaire

c_2 – Interview

c_3 – Controlled observations survey.

This classification of survey studies can be shown with the help of three dimensional 2 × 2 × 3 diagram.

Survey research as defined by Kerlinger deals with the incidence, distribution and interrelation of sociological and psychological variables.



Some important types of survey researches have been described in the following paras:

DESCRIPTIVE STUDIES

No category of educational research is more widely used than the type known variously as the survey, the normative surveyor descriptive research.

Descriptive research is concerned with the present and attempts to determine the status of the phenomenon under investigation.

The Nature of Descriptive Research

The nature of descriptive research can be explained with reference to other type of research.

(a) Descriptive and Historical Research (Longitudinal or cross sectionals)

A clear distinction can be drawn between survey studies and historical studies on the basis of time, the latter deals with past, the former with present.

(b) Descriptive and Experimental Research

Descriptive research as are oriented toward the determination of the status of a given phenomenon rather than toward the isolation of causative factors accounting for its existence.

It is based on cross-sectional samples, the sample should be representative of the population. Descriptive research involves large sample and experimental research includes small sample. Descriptive research investigates trend of characteristics of population. This is less scientific and sophisticated.

(c) Descriptive and Case Study

Both types of research establish cause and effect of relationship.

Purpose of Descriptive Research

The following are the main objectives of descriptive research:

1. To identify present conditions and point to present needs.
2. To study immediate status of a phenomenon.
3. Facts findings.
4. To examine the relationships of traits and characteristics (trends and patterns).

The descriptive survey is more realistic than experimental research. Descriptive researches are oriented towards the descriptive of the present status of a given phenomenon.

Special Problems of Descriptive Research

1. The problem of sampling, to select representative sample (size of the sample).
2. The validity of the measuring instruments. Validity of the tool is crucial to the validity of the findings of study.

Types of Descriptive Research

(*a*) Survey Testing,
(*b*) The questionnaire, and
(*c*) Interview.

Survey Testing: Survey testing researches are concerned with academic and psychological problems in which academic and psychological tests are administered for data collection. This type of research includes following types of problems:

(*a*) Selection of tests, because number of meaning instruments have been developed for measuring same trait or variable. The problem which of them should be taken up for data collection. For this purpose following considerations would be kept in view:

1. How the test defines the variable and the investigator should also define the variable in the same way.
2. Validity of the tool.
3. Ease for administration, scoring and interpretation.

(*b*) Construction of Tests. It may be possible that appropriate tool is not available for measuring the same variable. Hence, the researcher has to construct the tool. He has to estimate reliability and validity of the tool, it is not essential that norm should be developed. He has to follow the standard steps.

(*c*) The major difficulty is the applicability of the test norm to the particular group under study. Because every test has limitations that it can be used for some specific population.

Use of Survey Testing Results: Survey testing, as a research activity, usually is interested in evaluating the achievement of a class, a school, relationship of variables, educational and vocational guidance and standardization of test. Researches. of these types reveal the weakness of scholar's programme. It can be used evolving the criterion of admission and selection. These researches can be used as policy discussions.

Characteristics of Survey Testing Research: The following are major characteristics:

1. Descriptive-survey-test research are relatively more scientific and accurate.
2. It provides more accurate data.
3. The data are subjected to parametric treatments.
4. The sample is usually of large size the error of measurement and sampling error is put to the minimum.
5. The findings are authentic and accurate.
6. The conclusions are realistic.
7. It provides the deep insight to the psychometric methods of test construction.

(*a*) Achievement Testing: Survey testing of educational attainment has become a large and well established part of school surveys. Achievements test of objective type are constructed for this purpose. Such achievements testing surveys may serve in any purposes:

1. They may enable the researchers to compare the performance of the present pupils with those of previous years or of different schools.
2. They may be taken as suggestive if not a very reliable evidence, of the quality of teaching.
3. They may be used as one of the means of rating different educational institutions.
4. They may form a part of large complex studies of other types than survey e.g. in experimental and complex casual studies.
5. The principal or teachers may use the results of city or of state wide survey testing for a critical analogies their own school or classes.

(*b*) Intelligence Testing: Although it is used to a much less extent than the achievement tests in school surveys, yet intelligence tests are a very important tool for educational researches. The many purposes for which survey intelligence testing has been used are:

1. For dividing large classes into relatively homogeneous sections.
2. An diagnosing and adjusting individual children in educational and vocational guidance.
3. For studying the socially or educationally mal-adjusted children.
4. For estimating the aptitude i.e. for prognosis.
5. For scientific study and experimentation.
6. For ascertaining the intellectual level of pupils who enter the college. who succeed in the school but do not enter the college and who do not succeed in school.
7. For constructing and adopting the various intelligence tests.

(*c*) The Personality Testing: Though difficult to define analyze and measure they still have given rise to some instruments for survey testing in the field of personality, character and adjustment which embrace a wide variety of techniques. Questionnaires, interviews, observations, check-lists and rating scale as also some carefully pre-arranged social situations are frequently employed in addition to written tests.

Personality testing includes: school appraisal studies:

School Appraisal

"Appraisal is a form of classification or scaling according to subjective values."

– C.V. Good

It is an attempt to measure not the objective characteristics of a school, but the effect of those characteristics on human beings. Appraisal of different aspects of a school is an essential element in school survey. It is concerned with both the objective aspects of an educational institutions including its administrative provisions and practices and the educational attainments of its pupils. In other words. it takes account of both static and functional data or of conditions and outcomes. To achieve this aim besides attainment tests. a school case render a community and perhaps to compare these services with those that are provided by other schools. The ultimate aim of all school surveys in educational progress which they achieve by focussing attention on unfulfilled needs or unrecognized evils of a school system on the one hand and on worthwhile practices on the other.

Being a large and varied scope of school survey a single comprehensive school survey may be contributed of various parts or constituent surveys. The following are some such important parts of school surveys.

1. Survey testing:
   (*a*) Achievement Testing.
   (*b*) Intelligence Testing.
   (*c*) Personality Testing.
2. School Appraisal.
3. Status Study.
4. Financial Study.
5. Curriculum Study.
6. Building Study.

Now, we will discuss these parts which are important for school surveys.

1. Questionnaire Survey

This type of descriptive research uses the questionnaire as research tool for data collection. It is most frequently used in this type of research. Researches of this type are employed for school and educational survey and also for educational administration. Though this type of research is considered the easy yet the investigator has to face the following problem:

Problems of Questionnaire Survey

1. The first problem is faced in planning a questionnaire and its development.
2. Another problem is to get adequate answer or information through questionnaire. Return of questionnaire is always doubtful.
3. The reliability and validity of the data through questionnaire is doubtful.
4. Sometimes it is difficult to analyse the data. Only descriptive statistics can be used in this type of data.
5. Selection of large and representative sample.

Advantages of the Questionnaire Survey

The following are the main advantages of questionnaire survey research:

1. Among the major advantages of the questionnaire is that it permits wide coverage at a minimum expense of both money and effort. It affords wider geographical coverage it makes for greater validity in the results through promoting the selection of a large and more representative sample.
2. The validity of questionnaire data also depends in a crucial way on the validity and willingness of the respondent to provide the information requested. Research has shown that respondents are as a group of superior intelligence.

Disadvantages: The major disadvantages of the questionnaire are the possibility of the misinterpretation of the questions. Misinterpretations are due to the respondent's willingness or impersonality. Mailed questionnaire are usually impersonal. The reliability of the questionnaire is often ignored.

2. The School Surveys

A school survey generally is a comprehensive study of existing educational conditions undertaken to determine the overall effectiveness of the school programme with a view toward improvement where indicated. In a sense it is a form of accounting or inventory. It gathers information about various aspects of the school programme and evaluates than in the light of objectives of the school. It can be restricted to one specific element or one specific department but in general it is most useful when it is designed to accomplish the school programme. Comprehensive type of school surveys cover the following aspects:

1. Aims, outcomes, pupil achievement, curriculum, method and instructional aids.
2. Administrative problems and procedures.
3. Financial policies and procedures.
4. Operation and maintenance of the physical plant and related factors.
5. Pupil transposition, and
6. Staff and personals.

(I) Behaviour Studies: Centred round measuring such traits and self-reliance, initiative, spontaneity, judgement, cooperation, adaptability, etc. which form no mean goals of education.

(II) Attitude Studies: Centred round the attitudes of the pupils, parents or teachers towards courses of study, activities in or out of school, professions and problems, they may encounter.

Check lists, rating scales, or scores cards, the researcher must make use of other lines of evidences such as reputation, and subsequent success of the pupils.

The school appraisal surveys utilize in one instance or another the whole range of normative survey procedures including the following:

1. Analysis of available basic data.
2. Score card and rating scale.
3. Standard tests.
4. Case study.
5. Experimental procedure.
6. Interview or questionnaire.
7. Observation.

The school survey includes the following steps:

1. Preparation of plans.
2. Preparation of adequate tools.
3. Gathering data.
4. Interpretation of data and conclusions.
5. Preparing report.

In the adequate tools the following are mainly used :

1. Questionnaire.
2. Tests.
3. Rating scales, and
4. Score cards.

(III) Curriculum Studies: As a part of school survey, the object may be merely to analyse the existing curriculum in a school system and perhaps to compare it with that existing elsewhere. But if it is carried on as an independent study, it may take a more complicated shape. It may include or analyze the principles on which the curriculum is based, the needs it fulfils, the form it has taken and the shortcomings it suffers from. The relation to the community, it serves, may also be determined.

(IV) Building Surveys: The survey of school buildings for the purpose of planning or evaluation or just for the sake of information, is not common feature. It usually forms parts of comprehensive or wider school surveys. The questionnaire, check list, score cards, observation are the usual tools for collecting data about buildings, their right, and location, the accommodation they provide, the arrangement they have for various classes, subjects activities or staffs, the conditions they are in as regards the construction and cleanliness and the improvement or the whole procedure is however purposive, not mechanical application of steps and techniques.

(V) Status Studies: To determine the status including personal and professional characteristics of various school officials and teachers may be a part of a school study or the subject for the independent study. The questionnaires are the main means employed by the investigators for such type of study. Officials records are also utilized for the purpose. The problem of the selection placement of the teachers, their teaching load, their status with regard to tenure, health, law supply and demand, etc., all form the subjects of such a study.

(VI) Financial Study: The financial position of a school forms an important aspect of school studies. To ascertain the sources of finance, the items of expenditure, the deficit or indebtedness, expenditure per pupil, and teachers salaries, etc., are the main aspects for the financial study of a school. For this purpose the questionnaires are generally used. The financial study of a school helps to a great extent, in the status study expansions they stand in need of these studies too may be independent and complete in themselves or comparative of part of wider school surveys. Building surveys commonly deal with the background and setting of schools, an estimate of future school, and available financial resources for school buildings.

3. Documentary Frequency Studies

A definitely quantitative type of normative research documentary frequency studies are undertaken to identify and count certain characteristics found in documents under consideration. They deal with a systematic examination of currents, records documents, etc. and may merely gather and classify data from such documents or may also evaluate the content according to some established criteria.

A study of this type involves the problems of following types:

1. Problem of ascertaining the purpose of the study.
2. Problems of determining what characteristics to count and to define them.
3. Problems of selecting documentary specimens for investigation.

The documentary studies may serve the following purposes:

(*a*) They may describe prevailing practices or conditions.

(*b*) They may discover the relative importance or interest in certain topics or problems.

(*c*) They may discover levels of difficulty of presentation in text books or other publications.

(*d*) They may evaluate element of bias or propaganda in text book presentation.

(*e*) They may analyze types of errors in standard's work.

The sources of data for documentary studies may be:

1. Official reports and records,
2. Printed forms, text-books, and reference books,
3. Letters, autobiographies, and diaries,
4. Compositions, themes, or other prepared works,
5. Books, magazines, newspapers,
6. College bulletins, Catalogues, syllabi, and
7. Pictures and cartoons, etc.

Types of Documentary Studies: The following are the main types of documentary studies:

1. Text book analysis,
2. Analysis of longer bodies of literature,
3. Curriculum analysis,
4. Job analysis, and
5. Analysis of assembled specimens:
   (*a*) Vocabulary analysis,
   (*b*) Error studies, and
   (*c*) Analysis of characteristics of school records and reports.

4. Survey Appraisal Studies

Appraisal studies of certain aspects of existing educational phenomena like schools, students, teachers, text-books, etc. are also of the normative survey type, survey appraisal studies learn more heavily upon the human element than surveys of other type; especially because appraisal is itself an attempt to determine the effect of characteristics upon human beings.

The studies that involve the direct judgement commonly use the jury technique whereby the judgement of a number of persons with regard to certain persons, features or specimens is pooled to secure a final verdict. Check lists attitude scales, scaled specimens, rating scales, score cards and index numbers are the tools commonly used for the purpose of appraisal. These appraisal instruments are based on two fundamental assumptions:

(*i*) One assumption is that better judgement can be secured on the significant aspects of an object or situation by focussing attention on one aspect at a time.

The other assumption is that a general value can be approximated by assumption of the value of the parts.

In so far as both these assumptions are open to doubt and criticism these instruments of appraisal fail in being perfect. Yet they are not without their use.

"After all appraisal schedules are normative instruments, they reflect general tendencies, tempered by the superior and by the inferior, but they represent in the main, thinking we are most used to."

– C.V. Good

5. Follow-up Studies

The follow-up studies form another type of normative survey investigations which study individuals who have left an institution after a course of study or programme of work. They concern themselves with engagements, occupations, or status of the individuals, subsequent of their study and the impact of their previous institution and programme upon them. They examine the status of those who have passed out of an institution or seek their opinions directly as to the value of the courses, experiences or treatments received at the institution.

The follow-up study may serve the main purposes given below:

1. They may prove the adequacy or otherwise of the institution's programme of work.
2. They may lead to the improvement of the curriculum, syllabus, methods of teaching, administrative procedures. guidance and service. etc.
3. They may provide the valuable information on the process of selection or recruitment of the candidates for a course.
4. They may evaluate the influence of certain psychological, social educational factors found among youngsters on their after life.

The various tools used singly or in combination in follow-up studies are:

(*a*) Questionnaires, (*b*) Check Lists (*c*) Rating scales,
(*d*) Attitudes Scales (*e*) Score cards (*f*) Interview and
(*g*) Observation.

EXERCISES

1. Define the term 'method'. Differentiate between method of research and strategy of research.
2. Distinguish between methods of research and methodology of research. Illustrate your answer with examples.
3. Classify the methods of research. Give various ways of classifying methods of research. Differentiate between longitudinal and cross-sectional approach to educational research and illustrate your answer with examples.
4. What do you mean by survey method of research? Distinguish between Descriptive Survey and Analytical Survey method of research.
5. Mention the purpose and uses of survey method of research in Education.
6. "There are three criteria for classifying the survey research: Nature of Variable, Group Measured and Sources of Data." Illustrate this statement.

Chapter 7

Historical Method

History is the meaningful record of man's achievement. It is not merely a list of characteristics, of chronological events, but a truthful integrated account of the relationship between persons, events, times and places. Man uses history to understand the past, and to try to understand the present in light of past events and developments.

History is a branch of learning that studies the records of past events. History means an inquiry into the past to establish what has actually happened. The historian is influenced by some philosophy operating implicitly or explicitly in his interpretation.

Why to Study the Past: Historians, philosophers, social psychiatrists, literary men as well as social scientists, use the historical approach as an aid in visualizing society as a dynamic organism and its structures and functions as steadily growing and undergoing change and transformation. Social scientists in particular are interested or concerned with social change. Since all groups, social institutions and personalities undergo change to a lesser or greater extent (degree), and as a consequence, the social roles and forms of organisation they also assume subject to a process of change and transformation. The logician A.N. White Head, points out that "each emerging i.e., perceived as containing within itself all its past and seeds of its future." Paraphrasing a statement by George Bernard Shaw, "The past is not behind the group, it is within the group. The past if it can be located, contains the key to the present. Through today is different from yesterday, it was shaped by yesterday. Today and yesterday will probably influence tomorrow." We can hardly conceive of a social situation or a social structure which is not rooted in conditions and forces long in operations. Therefore, Historian Authur Schlesinger Warnas : "No individual let alone a social scientist, can wisely ignore the long arm of the past." Direct observation of the social phenomenon in a state of rest is not a sufficient foundation (for study), it gives neither requisites scope nor accuracy. There must be added a study of development of these phenomena in time, that is, history, especially Historians (Modern Historians) are interested in cultural change in time but change not in the time, is their true historical perspective. Although they acknowledge in indirect influence of the past on human experience. They stress the belief that "Behaviour depends neither on the past nor on the future but on the present field."

Meaning and Definition of History – The following are some definitions of history "History serves its greatest purpose as a record of the march of humanity on the road of progress in which sense it is very useful compass for taking bearings of the directions of our progress and measuring the speed of our advance."

– M. Verma.

History; in any field of inquiry, is an integrated narrative of past events representing a critical search for the whole truth. Historical approach to the study of any subject denotes an effort to recount some aspects of past life. The possible field for historical research is as broad as life itself. The use of historical sources and techniques in the field of education has been adopted from the universal application of the historical approach in the study of problem from scientific or social fields.

History is a reliable and meaningful record of the past of the human race considered in its wider and more general aspect. That humanity is peculiarly privileged to possess and maintain such a record and has need to do so is naturally to be considered next.

The origin of the word history means the search for knowledge and truth. Good and Scates rave defined history in the following manner–"History is any integrated narrative or description of past events or facts written in a spirit of critical inquiry for the whole truth."

"In academic terminology history refers largely to political history although the recent trend is to trace the political history of a country against the background of economic, social and cultural developments."

– M. Verma

"Historical composition is a synthesis and constructive processes that involves the mechanical problem of documentation of the logical problem of selection and arrangement of topic and sub-topic and philosophical problem of interpretation."

– Good and Scate

"An advantage of history that is often overlooked is its effect on the personality of the students and teacher including past events and facts. Scientists prove evidence for fact but no effect."

Thus, history is the combination of facts and imagination of historian.

WHAT IS HISTORICAL RESEARCH?

The following are the meanings of historical research

1. Historical research is the application of the scientific method of inquiry to historical problems. It demands standards of careful methodology and spirit comparable to those which characterize other types of research.
2. It involves identification and limitations of the problem, formulation of the hypothesis, collection, organization, verification, validation and analysis of data; testing the hypothesis; and writing of the historical account. All of these steps lead to new understanding or the past and its relevance to the present and future.
3. Historical studies is education provide important information concerning the effects of certain past educational practices and may suggest programmes for future action, based upon the evaluation of these past experiences.

They also offer an explanation of the how and why of many of the theories and practices that have developed and that now prevail in the schools.

They help educational workers to identify and evaluate fads and bandwagon schemes that have appeared on the educational scene before.

They also contribute to an understanding of the significance of education and the inter-relationship between the school and the curriculum.

"A historical research is the critical investigation of events, developments and experiences of the past, the careful weighing of the evidence of the validity of sources of information of weighed evidence."

"Historical research deals with the past experiences..... . Its aim is to apply the method of reflective thinking of social problems, still unsolved, by means of discovery of past trends of event, fact and attitude. It traces lines of developments in human thought and action in order to reach some basis for social activity."

PURPOSE OF HISTORICAL RESEARCH

The purpose of which historical research is undertaken is probably as varied as the many individuals who engage in the activity. They can be summarised into two major categories:

1. The foremost purpose of doing historical research is to gain a clear perspective of the present. Present problems e.g., racial integration or the recent opposition federal aid to education are undertaking only on the basis of third historical background. Most current events have a past "History" and it is generally necessary for us to acquaint ourselves with this history if we appreciate their real significance.
2. An understanding of the history of education should enable the educators to recognise the weakness of the educational system.
3. A common motive underlying historical research is the desire of the scientist to arrive at an accurate account of the past. This may involve nothing more than a scholarly interest in truth, i.e., the desire to know what happened and how? and why? the men of the times allowed it to happen.

APPROACHES OF HISTORICAL RESEARCH

There are two approaches of historical researches - Perspective and Retrospective approach.

1. Perspective Approach : To study the events from the past towards present.

2. Retrospective Approach: To study the events of present and proceed to past events.

The first approach is ancient approach while the second is a recent one.

Another two approaches of historical research:

(*a*) Ancient – To study the political personality, individualistic approach.

(*b*) Recent – To study the phenomena in social milue group approach.

Ancient – Past to present-Prospective.

Recent – Present to past-Retrospective.

The purpose of historical approach or history is to understand the present in the light of past to enlighten the future. It is a time sense approach. There are three methods which concern with the time sense approach.

1. Historical method-Past and Present.
2. Case Study-Past, Present and Future.
3. Genetic method-Past.

Historical method is an approach in the research study to the past history or to recount some aspect of past life. Good and Scate have defined the approach and given two aspects:

1. A synthetic and constructive process.
2. The mechanical problem of documentation.

1. A Synthetic and Constructive Process: It is a combination of similar different views in a constructive way, the method historical criticism In such a way. Is the desk work. It is a process of analysis and synthesis of records and documentation.

2. Mechanical Problem of Documentation: This approach depends upon the mechanical problem of data collection. The documents are interpreted on the philosophical or logical basis. Interpretation of documents should be done objectively. The subjectivity may be eliminated by philosophical interpretation.

FUNCTIONAL HISTORY OF EDUCATION

Emphatic views have been expressed advocating development of a functional history of education. E.H. Reisner maintains that sound thinking about the social process of education must depend upon a knowledge of the origins which influence the present state; that the serial approach makes easier the recognition and identification of significant casual factor in the complicated present situation; and that an understanding of the insights of educational thinkers of the past may protect us against ready acceptance of the half-truth as well as reveal the comprehensive meaning of education which the future makes into a reality.

History of education seeks to answer:

1. The question of evolution.
2. The question of resemblance.
3. The question of value.

Historical Sources

There are three major steps of historical method :

(*a*) Collection of data with consideration of documents and remains of relics, of primary and secondary sources, of bibliographical procedure and of organization of materials.

(*b*) Criticism of the data collected including the processes of external criticism and internal criticism.

(*c*) The presentation of the facts in readable form, involving problems of organization, composition exposition and interpretation.

Types of Historical Research

Historical research which is concerned with the past and which attempts to trace the past as a means of seeing the present in prospective.

Historical research can be classified according to :

1. **Approach:** The pragmatic approach used by Karl Marx to arrange the facts of history to support his concept of socialism.
2. **Subject:** The bibliography of a given person monography of a town, state, nation or civilization or slightly higher level the history of ideas, institutions or trends.
3. **Technique:** It is based either on documents or relics. Another way of classification research is of four types:
   (*a*) Classical studies in Historical Research
   (*b*) Documentary Research-It excludes remains as source and considers only documents.
   (*c*) Bibliographical Research-It includes history of a unit (nation, person, culture).
   (*d*) Legal Research.

The Steps of Historical Research

Although slight adaptations from standard scientific methods need to be made because of its nature historical research must meet the same criteria and generally follow the same procedures as the forms of research:

1. **Identification and Definition of the Problem:** It is a difficult proposition since it involves not only the location of the problem, which has a historical significance, but also the availability of adequate data.
2. **Collection of Data:** Collection of data may involve anything from digging up ancient ruins to stumbling on old documents or remains. Although occasionally material in fold manuscripts located by chance, most educational data probably have to be gathered in the routine fashion by giving through minutes of meetings diaries, etc. In this way data are collected by two sources primary and secondary.
3. **Criticism of Data:** The establishment of the validity of data generally involves the dual process, of first establishing the authenticity of the sources and then the validity of its content. Interpretation of Data: Interpretation of data must be made from standpoint of whatever hypothesis or theory of the data will most adequately support. It is necessary that data be considered in relation to one another and synthesized into a generalization or conclusion which places the overall significance in focus.

Sources of Historical Data or Evidences

Historical evidences may be classified into two categories: (i) Documents, (ii) Relics or remains-according whether or not the source was intended to transmit the information, or whether it simply an artifact. Documents are usually written whereas relics, e.g., archeological remains such as tools and utensils, are not. But this is not the basic point of distinction. A letter written by Gandhi, e.g. would be a document from the standpoint of the information it contains, but would be a relics from the standpoint of spelling errors, handwriting, or other features that provide information apart from the message Gandhi wished to convey.

(*a*) Various Documentary Sources are

1. Official Records - Minutes of meetings, committee reports and legal documents, court decisions, legislative act, charter, etc.
2. Institutional Records - Attendance rolls, university bulletins, university executive council proceedings and minutes.
3. Memoir, biographies, diaries, personal letters, books on the philosophy of a given scholar, etc.
4. Newspapers, periodicals, journals.
5. Literary material.
6. Catalogue, syllabus, prospectus etc.

(*b*) Relics or Remains

1. Building, furniture and equipment.
2. Library and their furniture.
3. Photographs and other records.
4. Forms of degree, diploma, certificate, records, registers.
5. Text-books, exercise-books, maps, drawings, etc.
6. Written material.

Obtaining the best data available to solve a problem is an initial and important task of a historian. Historical sources are usually classified into two main categories - Primary and Secondary sources.

Primary Sources of Data

The original document or remains which are the first witness of a fact are termed as Primary Sources. Primary sources are the only solid basis of Historical Research and they are highly prized by a historian.

A primary source is the only repository of an historical datum, like an original record kept of an important occasion an eye witness description of an event, a photograph minutes of organization meeting and so on.

Documents or records kept and written by actual participant in, or witness of an event. These sources are produced for the purpose of transmitting information to be used in the future. Documents classified as primary sources are constitutions, charters, laws, court decisions, diaries, deeds, genealogies, contracts, wills, autobiographies, letters, official minutes or records, permits, licenses, affidavits depositions, declarations', proclamations certificates, lists, bills, handbills, receipts, newspapers and magazines, accounts, maps diagrams, books, pamphlets, catalogues, films, pictures, paintings, recordings, transcriptions and research reports.

Remains or relics associated with a person, group, or period, fossils, skeletons, tools, weapons, food utensils, clothing, buildings, furnitures, pictures, paintings coins and art objects are examples of these relics and remains that were not deliberately intended for use in transmitting information or as records. However, these sources may provide clear evidence about the past. The content of an ancient burial place, for instance may reveal a great deal of informations about the way of life of people-their food, clothing, tools, weapons, art, religious beliefs, means of livelihood and customs.

Oral Testimony, or the spoken account of a witness of or participant in an event. This evidence is obtained in a personal interview and may be recorded or transcripted as the witness relates his experiences.

Secondary Sources of Data

It is necessary in some historical research studies to begin with secondary data and to work well when primary source of data is not available, e.g., text-books, encyclopaedia, bibliographies.

In the words of *Kerlinger* –

"A secondary source is an account or record of an historical event or circumstance one or more steps removed from an original history.

Secondary sources are the reports of a person who relates the testimony of actual witness of, or participant in an event. The writer of the secondary source was not on the scene of the event, but merely reports what the person who was there said or wrote. Secondary sources of data are usually of limited worth for research purposes be because of the error that may result when information is passed on from one person to another. Most history books and encyclopaedias are examples of secondary sources.

Some types of material may be secondary sources for some purposes and primary sources for other, e.g., a high school text-book in American History is ordinary of a secondary source. But if one was making a study of the changing emphasis on nationalism in high school American history text-books, the book will be a primary document or source of data.

Historical Criticism

In historical method we can not use a direct method of observation and what has happened can not be repeated. Therefore, we have to depend on data. Trustworthy usable data in historical research are known as evidences or evidences or witnesses those, who have participated in the events. So that data

must be subjected to make a careful analysis to shift the true from false or misleading informations.

In the words of *M. Varma* –

"Within this classified data, which is like ore from mines, a lot of cross-referencing and collection is necessary to cancel out error and spurious elements. This is logically so simple a process as to be close to more common sense, but requires a good memory for detail. If one has been generous in gathering data some elements may have been caught in the net of which at the end do not appear gathering and may at this stage be rejected. The rest may be subjected to what is known as 'external and internal criticism.'

This evaluation or criticism involves the dual purposes of establishing the authenticity of the source and also the validity of its content. These are external and internal criticism/lower and higher criticism respectively.

(A) External Criticism

In 'external criticism' we consider the source material itself and decide its genuineness. It is like this asking mausoleum of Sher Shah or is it a case of mistaken identity. Spurious material, forgeries and other 'misleads' are here uncovered and this requires a lot of erudition in the researcher and a wax tablet memory.

The purpose of external criticism is to establish the authenticity of the source of data, whatever it is reliable or not. Various tests may be used to ascertain the authenticity or genuineness of data. The problem of establishing age or authorship of documents may involve many tests of handwriting, signature, type, spelling, language, usage, knowledge available at the time, and the consistency with what is known. It may involve physical and chemical tests of ink, paper, stone, wood or metal, etc.

(B) Internal Criticism

Having settled the authorship and date of document and its genuineness we next proceed to the 'internal criticism', i.e., an evaluation of the content or the information contained in the source.

The purpose of internal criticism is to ascertain the truthfulness or creditability of the data. After testing the authenticity of a historical data it is also essential to judge its accuracy and worth. It may be genuine but may not reveal to be true picture what the writer or creator was one competent enough or he actually knows this fact.

These questions are often difficult to answer but the historian must be sure that his data are authentic and accurate. So the accuracy and precision of data is examined by an internal criticism.

"A document may survive external criticism and still be subject as evidence, there may be no doubt of the 'true' author or recorder of events and he may be competent. Willingly or unwillingly, however, he may have distorted the truth. Internal criticism, in brief, seeks the true meaning and value of the content of sources of data."

After internal criticism data is used for the presentation of facts. So the criticism of data both internal and external establish the reliability and validity of data (authenticity and validity of content, i.e., accuracy).

Presentation of Data

After the data have been subjected to an external or internal criticism the problem of synthesis or ordering or organization and presentation remains. Now data must be organised in a chronological sequence or way. The descriptive statistics may be used in analysing the data but steps of historical research need a greater deal of imagination and resourcefulness and careful method of logical thinking.

This process is also known as synthesis.

Synthesis is of two parts –

(*i*) *Chronological Synthesis*: In this synthesis we collect the facts year wise.

(*ii*) *Topical or Theme wise Synthesis*: In this synthesis we collect the facts theme wise or topic wise.

Interpretation of Data

The accumulation and variation of historical data, while crucial, is only a step to the even more important task of interpreting their significance. Here the historian is on extremely subjective grounds, and he must be careful not to part company with his scholarship.

In spite of underlying philosophical conflicts and personal prejudice a 'common historical consciousness' should emerge if the correct historical method is applied. Obviously historical objectivity is not the same as that of the scientist on account of the need of the historian to apprehend his form of truth from within by act of intuition. Was he to adopt the detachment of the scientist he would become a mere chronicler and miss all the 'significance' of history. He has to achieve a truthful reconstruction of the past in all its complex relationships and tendencies by imaginative and yet logically valid means.

This constitutes a major test of his claim to scientific status. His first task is that of making sense out of the multitude of facts he has gathered, an operation which generally calls for a synthesis of data in relation to a hypothesis or theory rather than mere accumulation or summary.

The establishment of causation is particularly precarious. On the other hand, it is precisely through the display of his grasp of the field, clarity and plausibility of his interpretations, his ability to bridge the gaps, the continuity and the perspective which the superimposes on these data to make them meaningful that the historian establishes his claim to scientific status.

WRITING THE REPORT

No less challenging than research itself is the writing of the report which calls for creativity in addition to the qualities of imagination and resourcefulness already illustrated. Research report should be written in a style that is dignified and objective. However, the historian is Permitted a little more freedom in reporting. Homer Carey Hockett–suggests that the historian is not condemned to a bald, plain, unattractive style, and that for the sake of relieving the monotony of statement and after statement of bare facts, it is permissible, now and then, to indulge in a bit of colour, however, by warming that above all, embellishments must never become a first aim, or be allowed to hide or distort the truth.'

While the writing of the historical report must unavoidably and desirably-allow for a somewhat greater degree of freedom in the use of subjectivity than does the usual research report, this is not a license for the historian to let his imagination and his personal basis distort the facts.

Historical Research: Is it Scientific?

An issue which has been raised respectively -though perhaps not always profitability concerns the scientific status of historical research. The issue centres round the definition of terms and the criteria used. The status of historical research as a scientific endeavour can hardly be questioned, if the criteria are defined in terms of its reliance on critical methods of discovery and of scholarship. If, on the other hand, we insist that science be oriented toward the discover of laws capable of conclusive verification, historical research probably does not qualify as science. These are three tasks in historical research:

(1) the collection of data; (2) the treatment and interpretation of data; and (3) the derivation and conclusions and generalizations. From a strict point of view, historical research can be criticized for failure to meet the criteria of science in all the three main tasks:

1. **The Collection of Data:** Historical facts are not 'knowable' in the same as the facts of the physical sciences; they have to be inferred and accepted on the basis of plausibility. Historical research is generally based on unique events which occurred but once and which cannot occur again or repeated.
2. **The Treatment and Interpretation of the Data:** Historical problems, on the other hand, since they deal with unique events, are verifiable only on the basis of logical deduction. It is very difficult for the historian to make an adequate analysis of diaries, letters, etc. often he must deal with a profusion and complexity of data produced under varying conditions of insight and incentive.
3. **Products of Historical Research:** Historical research can also be criticised from the standpoint of the products it seeks to provide on the concept of causation, which is especially confusing in the case of historical research.

In summary, historical research can be considered lacking a number of the characteristics of the scientific method, interpreted in its narrow sense.

Concluding Statement

History of education was relatively with frequent requirement in our country. Historical researches will reveal the past history of development and their failures which will provide some insight for the present developmental change, in the field of education. Historical researches should be written objectively and in a dignified way.

Examples of Historical Research

Some examples of historical research are:

1. Development of teacher education after independence.
2. Women's education status in independent India.
3. Failures of basic education and its educational history after 1947.
4. Technical and vocational education in free India.
5. Educational philosophy in Bhaktikal (with special reference to Kabir, Tulsi and Sur).
6. A historical development of adult education or social education.

Criteria of Evaluating Historical Research

A number of criteria may be used to evaluate the adequacy of historical research. The following are the major points to evaluate such researches:

1. Has the problem been defined clearly? Is the problem capable of solution? Is it the competence of the investigator?
2. Are the data of a primary nature available in sufficient completeness to provide a solution or has there been over dependence on secondary or unverifiable source?
3. Has the dependability of the data been adequately established? Has the relevance of the data been adequately explored ?

4. Does the author display adequate mastery of his data and insight into their relative significance? Does he display adequate historical perspective? Does he maintain his objectivity? Does he see the relationship between his data and other historical facts?
5. Does the style of writing attract as well as inform? Does the report make a contribution on the basis of newly discovered data or new interpretation? Does it reflect scholarliness?

Limitations of Historical Research

Historical research has considered a great deal towards education but this was mainly before 1920. After this historical research has received a great setback through the later studies of Thorndike, Terman and Hull, etc., who contributed towards the progress in the field of education. Relatively in the present period, more emphasis is laid on scientific researches. On the other hand the use of the rigid scientific method in historical research presents great difficulties:

Firstly, it is very difficult to study historical events on the basis of cause-effect relationship.

Secondly, many obstacles hinder the objectivity of the study.

Thirdly, it is very important for the investigator to have a special historical perspective. Besides these limitations importance of historical research has declined due to use of scientific method in social sciences.

"The history of education and historical research in education have suffered a serious decline, in part because of the impact of scientific research."

EXERCISES

1. Define the term 'History'. What is historical research?
2. Enumerate the need and importance of historical research in education.
3. Indicate the functions of history in education and historical sources.
4. What are the various types of historical research? Describe the various steps employed in historical research. Give some examples of historical problems.
5. Differentiate primary sources and secondary sources of historical research. How are their reliability and validity examined?
6. Distinguish between external criticism and internal criticism. Both types of criticism are essential in historical research and why?
7. Explain the role of hypotheses in historical researches. Can the hypotheses be formulated in historical researches? Support your answer with certain arguments.

Chapter 8

Philosophical Method

The educational researches are designed to achieve the following four objectives:

- To formulate new theory, principles and laws,
- To establish new truth or reality,
- To find out new facts, and
- To suggest new applications.

These objects are achieved by conducting historical, experimental survey and philosophical researches. The philosophical researches are conducted to establish truth or reality. Education has two respects: theoretical and practical. The practical aspect is enriched by scientific researches and conducting philosophical researches can develop theoretical part of education. Our system of education is based on the western philosophy. The theoretical aspect of our education is not our own, it is borrowed from the west. Therefore, it is an urgent need to evolve our own theory of education with the help of philosophic research of education. The author of the book has attempted in this chapter to provide a guide line for the philosophic method of research.

MEANING OF PHILOSOPHY

Philosophy tries to comprehend lived experience or 'concrete action'. Emmanuel Kant ascribed a 'critical' function to philosophy. This function is concerned with an inquiry that begins from given experience or body of knowledge and seeks the intelligible conditions of its possibility.

Philosophy is like science and inquiry and has like science problematic origin; only its problem is of a different nature. It has to make lived experience 'intelligible' to us in the sense of comprehending it as a meaningful, logical and coherent whole. Indian term Darshan is an equivalent of philosophy. The word Darshan literally means 'seeing'. The 'seeing' is a vision of the entire experienced reality; it is all encompassing, for it is the vision of truth itself. Darshan has an extra implication; it includes a realization, an experience of the postulated truth which takes it beyond mere' polemics. The term philosophy requires in its sense an intelligible and coherent accounting of the life experience.

The term philosophy may become more clear if we say what philosophy is not.

- It is not speculation, i.e. unreal or unverifiable. Philosophy is not a speculative discipline in the sense that it begins with gratuitous assumptions about man or the universe.
- It is not religion, although the philosopher may deeply concern about the nature of God or the possibility of immortality of man.
- It is not a way of life, in the sense in which we sometimes refer to a person's "philosophy of life". It is not the poetic appreciation of a beautiful sunrise.

Philosophy is a disciplined, orderly, logical study of the universe, i.e. of literally everything all reality.

Philosophical inquiry is reflection upon human experience in order to decipher the fundamental principles of reality and eventually the principle of existence itself. Philosophy is a disciplined study of experience. Philosophy is non-scientific esoteric or supra experimental.

Philosophy is experiential – which eventually leads all philosophical inquiry to its primary task, namely to understand what it means to exist.

Philosophy is experiential, and it is "the personal presence of the philosopher who I am to reality", Le, is the starting point of all philosophy. Man's experience is essentially and inevitably an experience of existence.

Philosophy contemplates what the other disciplines do not; it fills a void, so to speak, left by all the other efforts of man to understand reality; it culminates man's unending quest for certainty. The psychologist studies the behaviour of man while philosopher is concerned about human behaviour to know what humanity is. What is life? Is there an ultimate principle of life? Thus, philosophy is not superfluous; it is a study of the universe and man.

Philosophy is a relentless investigation of underlying propositions of the empirical sciences; the verification of our most radical assumptions about man and the universe; an inquiry into the nature of existence, life, reality, the good, the beautiful and the like.

NEED OF PHILOSOPHY

The philosopher, Maritain, has described this paradox in his essay, on the use of philosophy:

"Philosophy, taken in itself, is above utility. And for this very reason philosophy is of the utmost necessity for man. It reminds them of supreme utility of those things which do not deal with means, but with ends. For men do not live only by bread, vitamins and technological discoveries. They live by values and realities which are above time, space and are worth being known for their own space; they feed on that invisible food which sustains the life of the spirit, and which makes them aware, not of such or such means at the service of their life, but of their very reasons for living and suffering and helping."

The purpose of the philosophy is to inquire into the truth of ultimate proposition about existence, life, and reality, good and so forth.

The philosopher in society witnesses to the supreme dignity of thought he points to what is eternal in man, and stimulates our thirst for pure knowledge and disinterested knowledge, for knowledge of those fundamentals about the nature of things and the nature of mind and man himself, and God which are superior to and independent of, anything we can make or produce or create and to which all our practice is a pendent, because we think before acting and nothing can limit the range of thought: our practical decisions depend on the stand we take on the ultimate questions that human thought is able to ask. That is why philosophical systems, which are directed toward no practical use and application, have such an impact on human history.

Philosophy pursues the most basic, fundamental or ultimate, therefore, the most radical questions that can be raised by the human intellect questions which lie at the very periphery of human reason. Philosophy seeks answers to the ultimate questions reality, paradoxically it is the bulwark of the other disciplines and therefore eminently useful and at the same time it is above mere utility.

A pervasive element like philosophy offers endless scope of research. It is co-existent with the fact human conduct and life. Philosophy in such usage means the related theory, which arises from and in return governs a given practice. It is true that theoretic constructs and consideration of why and wherefore can be conceived of and produced for any human activity.

PHILOSOPHY OF EDUCATION

The term 'philosophy of education' is regarded as somewhat presumptuous by more conservative type of person. It is felt that education is a practical activity whereas philosophy is concerned with ultimate and fundamental issues of life, death and the nature and existence of the God lead, and at least a direct and immediate relation between the two is not apparent to the naked eye. If philosophy in its last analysis is a way of life, education is the method inculcating that way of life in others. The details of that method are determined by one's theory of knowledge, concept of reality and the mind of man. The ends of human life and the means of attaining these ends are both important problems of philosophy. Therefore, no serious harm is done to philosophy if it is brought down from the high empyrean to consort with an everyday concern like education.

Philosophy of education means either the principles of philosophic thought applied to the field of education or the specific analysis-and the accompanying practical recommendations–i.e., philosophic analysis of education. The phrase "philosophy of education" is roughly equivalent to what we may consider to be a "way of thinking about" education. Philosophy is the contemplative side and education is the practical side of the same process.

According to many philosophers education is the active side of philosophy. To Adams education is the dynamic side of philosophy. John Dewey has defined philosophy as theory of education in its most general phases. According to him, the relation between philosophy and education is not general but very close, because it is education that gives necessary understanding of philosophy. The aim of philosophy is to enrich life for this some definite principles are translated into action through education. Thus, education should give a practical shape to the aims of philosophy.

The philosophy of education has followed one of several paths: The idealists, following a long tradition in the history of philosophy, point to the supreme importance of the individual and his mental awareness of reality, while the realists, with equally deep roots in the history of philosophy, focus upon the intransigence of objective, extra mental reality. Idealism and realism combine both generally present a humanistic philosophy of man.

The pragmatics, led by John Dewey, have for sometime assumed the role of prophets of democracy while attempting to show that mind does not differ from matter; that there is no permanent principles of truth or morality that knowledge is synonymous with behaviour; and that all is a constant state of change.

The existentialists emphasize the importance of a man-centred philosophy and theory of education which is impatient with abstraction and which tries to relate the whole of man to the whole of reality, as they are inextricably involved at any given moment.

A review of history of philosophy bears out that all eminent philosophers have discussed education as well. Philosophers from Socrates, Plato and Rousseau to John Dewey and other philosophers may be quoted in this context. Indian philosophers have gone a step further in this CO'1 text. Most of the philosophers of ancient period from Vashishtha, Vishvamitra to Dronacharya had been a great teachers. For giving a practical shape to his philosophical thoughts and views, Rabindra Nath Tagore established Vishva Sharti and Shri Aurobindo established the Pondicheri Ashram. Mahatma Gandhi also established Wardha Ashram and put forth his new system of education known as basic education. The main reason for this is that after sometime philosophers begin to feel their philosophical views can be made practical through education only, and the educationists feel that for reconstruction of ideals of life the help of philosophy is essential.

A philosophical analysis of education, if it is to serve the discipline must be as rigorous and articulate as any other philosophical investigation, which means that the student of educational philosophy must first acquaint himself with the rules of philosophic thinking and the heritage of the great philosophers of the past and present.

SCOPE OF THE PHILOSOPHY OF EDUCATION

The contribution of philosophy of education is considered to be significant in the field of education. All educational programmes such as aims of education, curriculum, educational resources, educational organization. discipline role of teacher and students, etc. are determined with the help of an educational philosophy. In determining aims of education, the contribution of educational philosophy is important because in the absence of the knowledge of related circumstances and problem is, the aim can not be formulated and without the aims success of education remains doubtful. Similarly, educational philosophy is important for curriculum-construction, because curriculum should not only help in the mental development of students but also in their emotional development. Thus, the scope of educational philosophy is the entire field of education.

John Dewey, explaining the scope of educational philosophy and science has expressed the view that philosophy of education formulates or determines the aims of education while science considers the means or methods of achieving them.

In modern times a good deal is being written regarding the philosophy that should guide and would mould our educational practices and objectives. Much able thinking has been directed towards these questions. Even so when one speaks of research in philosophy of education one is not easily understood. When so much discursive and systematic thinking has been done on education the need for analysing and systematizing it would arise. This is one business of philosophical research in education. Apart from famous educationists such as Comenius, Pestolozzi and Frobel very few persons have stated their philosophy of education formally in the manner of Plato and Dewey. It could even be postulated that educational principles and practices of a particular period are dominated by a particular philosophy, which needs to be abstracted and stated formally and directed.

THE METHODOLOGY OF PHILOSOPHICAL RESEARCH

In the discipline of research methodology, two approaches are followed: quantitative and qualitative approaches. The quantitative approach is employed in scientific research or inquiry. The qualitative researches are also equally important in area of education. It is used in historical and philosophical researches. This concept can be illustrated with the following example:

If a researcher asks, “How should mathematics be taught?” He is posing a legitimate research problem of empirical in nature. He is asking, “What means are most effective and most efficient for teaching mathematics?” But there is another question he may ask: “should mathematics be taught at all?” The first question is an empirical one: it suggests the observation and measurement of quantitative phenomena. The second question is, however, qualitative: it considers the value or the importance of mathematics. It may be answered in many ways, but whatever answer is given will depend in turn upon more far-reaching conclusions. If we say, for instance that mathematics contributes to the ‘good life’ or the development of the whole person. What is good life; what is a whole person?

It is true that we do not look to the philosopher to tell us how to teach or what administrative procedures to use; his conclusions about the fundamental questions of existence will inevitably shape the course of our behaviour in the classroom and the office. If human freedom is in reality, a myth we may expect to change our teaching accordingly. If truth were totally illusive, then we would be foolish indeed to pose as guardians of the truth.

Major Approaches in Philosophical Research

There are two major types of studies, which are conducted in the area of 'philosophy of education':

1. A system of Thought: First one is concerned with ascribing a system of thought or certain dominating concepts and master ideas to the nation, people, community or other group at a given time and demonstrating them as reflected in their life, achievements practices and literature.

2. A Critical Appraisal of the Thought of Great Personage: Second approach gives us a critical appraisal of the thought of a great personage or group of persons and demonstrates it in his or her or either utterance, private or public life and achievements.

The philosophical inquiry is usually made at least into the following areas: (*a*) Logic, (*b*) Metaphysics, (*c*) Epistemology, (*d*) Psychology, (*e*) Ethics, (*f*) Theodicy, and (*g*) Aesthetic

(*a*) Logic: The philosopher is concerned about the fundamental rules of thinking and the use of language. The logic has been called the science of correct thinking. It embraces a comprehensive body of principles relating to the nature of Ideas, judgments and the process of reasoning, as well as the symbolic form or the language in which these may be expressed. In the science of logic, the philosopher asks the following questions:

What is an idea?

What is the relationship between idea and the language?

We use to express them?

How might ideas be classified?

How do we express relationships between Ideas?

What is involved in immediate Inference?

How can we test the truth of our judgments and Inferences about reality?

Logic therefore, leads naturally to a study of metaphysics or what we call 'the science of existence'.

(*b*) Metaphysics: In the study of metaphysics the philosopher strives to understand what can be known about existence itself and what properties things have by the mere fact of existence. Metaphysics investigates the notions of being, cause and effect, relation, quality, essence, change, substance and accident. They usually ask the following types of questions:

What does it mean to exist?

What are the most fundamental characteristics of all existing things?

How can we account for individuality among things?

What are the fundamental laws of change?

Is there a difference between the essence of a thing and its accidental or chance modifications?

Are all things ultimately material or is there a non-material (non-physical) world of existents?

Are there basic and unutterable laws of existence, which govern all existing things?

Metaphysical type study is obviously difficult the very notion of existence is difficult to concentrate upon and yet we find the history of man's thinking from earliest times. Whatever are the answers to these queries, the universe is not basically intelligence without them.

(*c*) Epistemology: They are of philosophy that investigates the truth-value or the validity of human knowledge and the reliability of the sources of our knowledge is epistemology. Knowledge is a mental state, and therefore, apparently subjective phenomena. In this type of investigations the following types of queries are made:

What can the mind know, except its own ideas?

How can physical material beings make an impression upon unexpended mind?

In other words, how can knowledge be at the same time subjective and objective?

This question in turn leads to others about the validity of our knowledge of the universe.

What is the basis for our judgment about truth and falsity?

Are our senses and our intellect trustworthy instrument in giving knowledge of reality?

(*d*) Philosophical Psychology: The term 'philosophical psychology's' is sometimes used to distinguish this traditional study of the nature of man from recent empirical psychology. The philosophical study of man seeks to determine the most basic principles that make man different from other creatures and indicate the character of his behaviour and his destiny. Philosophers have sought to understand what principle underlies human nature:

What explains life, and the sentient and intellectual operations of man?

Does man have soul? If so, what is its nature?

How might the relationship between a soul and human behaviour be described ?

What do we mean fundamentally by personality?

Can a person be said to be free?

Is there such a capacity as 'free will'?

What does it mean to say man is a rational animal?

The answers of the above questions reveal the human nature and underlying principles.

(*e*) Moral Philosophy or Ethics: It sometimes referred to as 'practical philosophy', since the emphasis here is upon searching out fundamental norms of practice or conduct. It is to be noted that moral philosophy difference markedly from many empirical studies of human conduct. A philosopher is more interested to know what is 'good' as opposed to evil, and what essential rules of conduct or ultimate criteria of good behaviour are as opposed to immoral behaviour. In this type of investigation this philosopher asks the following type questions:

What does the dignity of the human personality rest upon?

Is there any such thing as a moral imperative?

What fundamental principles guarantee human rights and human equality?

What is the nature of law?

Can one speak of an eternal law?

What is the ultimate basis of civil authority and civil law?

Is man's destiny really found perfection and unending happiness?

In other words, in ethics the philosopher strives to establish the intellectual basis for practical moral conduct and even for criteria of political conduct and concept to international law. It is to the philosopher that we turn for the rational justification of concepts of justice, right, obligation and freedom.

Thus, a philosophical inquiry accomplishes at least two things:

(*i*) It bears witnesses to the truth in some form; and

(*ii*) It reflects the crucial concerns of mankind.

These are the two main functions of philosopher. The first function is a positive one, i.e., witness to the truth. The second function of philosophy, i.e., crucial concerns of mankind. It has more practical value.

The Historical Approach to Philosophy

This history of philosophical thought to the best introduction to this vital work. We are privileged to trace the sometimes-agonizing attempts of human minds enmeshed in human experience to define the major problems of human existence. And this is precisely where authentic philosophy should start. The historical approach to philosophy is preferable, in many ways, to the easy assimilation of the established vocabulary of a system or a school of philosophy, and saves us from the tragedy of mistaking a system or a school for the total truth. No school of philosophy or self-contained system of thought has ever succeeded in unraveling all the mysteries of the universe. Further, the historical approach to the study of philosophy places philosophic thought in the condition in which philosophic theses are born: in the uncertainties and the chaotic brevity of a moment in history. When we lose sight of this, we lose sight of the purpose of philosophic discourse, which is to speak of reality.

The historical approach to the study of philosophic thought brings one into direct involvement with the point of view of the philosopher. Although this may at first seem to disenchant philosophic speculation, to render. It is something less than disinterested or dispassionate research, at the same time the very notion of philosophy demands that it remains always in contact with the universe it studies. We are entitled to test the thought or the system for its inherent logical consistency.

Philosophical Foundation of Education

Different aspects of philosophy evolve a system of education. Metaphysics, epistemology and ethics of any philosophical thought provide aims, method of teaching, curriculum, educational administration, discipline and role of teacher and students to a system of education. These aspects of philosophy determine the nature and form of education.

(*a*) Metaphysics and Education: Knowledge of the reality or truth is called metaphysics. The nature of reality determines method of teaching and alms of education. Naturalism is a philosophy of metaphysics rather than epistemology. Most of teaching methods are given by the metaphysics of naturalism. The scope of metaphysics is the whole universe. It provides valuable guidance regarding knowledge of reality and its relative purpose.

(*b*) Epistemology and Education: The validity of human knowledge and reliability of the sources of our knowledge is epistemology. Idealism is a philosophy of epistemology rather metaphysics, hence most of the aims of education are determined by the philosophy of education. The contribution of epistemology to education is significant. It is epistemology that guides us what knowledge should be given to the students and how it should be imparted. It helps in organizing curriculum at different stages.

(*c*) Ethics and Education: A philosopher is more interested to know that what is 'good', and 'bad'. Ethics is concerned with behaviour of man. Decision on 'good' and 'bad' is very essential in education. Only those things, which are good, should be included in education. Thus, ethics is more valuable for education than psychology and sociology.

These aspects of philosophy help in determining the aims of education, methods of teaching, curriculum construction and educational programmes.

Philosophical Problem of Education

Philosophical research in education is however free of limitations from which historical research suffers. A researcher must have a wide background of relevant study to look for suitable topic.

There are two types of problem, which are, undertaken in the area of philosophy of education.

1. Problem is concerned with ascribing a system of thought and master ideas to a nation, people, community at given time.
2. The other gives us a critical appraisal of the thought of a great personage and demonstrates it in his or her life and utterance.

A philosophical inquiry depends on the availability of reliable source material.

A theme in philosophical research should be very important. It should be capable of yielding a system of thoughts that are worthy for researcher. A person like Gandhiji was interested in education and gave much serious thought to the subject in its national context and from the standpoint of his own philosophy of life. It could even be that he had a systematic philosophy of education, which he could never formally state.

If one proposed to investigate the philosophy of education during the mediaeval period of Indian history or the philosophy of education in works of the saint poets of Hindi. The question may be raised whether we are not looking for the proverbial black cat which is not in the dark room. This type of theme in philosophical research is highly risky because it has been proposed on the presumption the subject holds with its matrix the matter erudite research. This example indicates mistake to which most philosophical type of research in education are being conducted.

It is, for example, quite possible to speak of the philosophy of later Vedic or Buddhist education if it can be shown that the practices were based on a systematic view of life. An analytical and critical appraisal of the philosophy of an educationist can also be classed as research.

A pervasive element like philosophy offers endless scope for research in education. Philosophy in such usage means the related theory, which arises from and in return governs a given practice.

A part from seeking competent advice the researcher is advised to examine a preliminary sample of literature and judge for him the suitability of the material for the proposed research.

Techniques of Philosophical Research

It should be admitted that philosophical research does not require any elaborate technique. It is matter of erudition and analytical insight and synthesizing ability. It is a bookish business, even more than history, having to do largely with the close perusal of authoritative books and venerable tomes. The library technique and content analysis technique is used mainly in philosophical research.

It needs naturally a good knowledge of philosophical thought in general and familiarity with the major schools and trends. The insight and analytical faculty helps greatly in the interpretation of the data that is secured. The task of interpretation is mainly that of ascribing a significance, meaning

purpose and relatedness to a common end, to an apparently heterogeneous mass of data. Philosophy offers more freedom to the research worker.

If we ask a question like, "why we need a philosophical method or a philosophy of education?" We must answer that philosophy is essential to the study of education because it relentlessly investigates the substrata of our empirical inquiries; it seeks to verify the truth of our most radical assumptions about man and the universe.

If philosophy is the reasoned dialogue between mind and reality, we may say that the primary method or tool of the philosopher is the same as that of other sciences: the ineluctable law of logic. A biologist must interpret the data of his experiments or else that data remain meaningless-so to the philosopher who begins his research for wisdom with experience and the accumulated data of the other sciences, must interpret his experiences in the light of the particular problems he intends to study, The philosopher shares with all other scientists. He observes, hypothesizes, tests or verifies the logical consistency of his hypotheses and generalizes or draws conclusions. Therefore, the modus operandi of the philosopher does not differ substantially from that the scientists, although the apparatus of the physical sciences does not appear.

Procedure of Philosophical Research in Social Sciences

There are the usual stages of classification and collection of data from original sources; its analysis and careful shifting; its organization into a meaningful whole so that an intelligent circle of ideas is exhibited with neatness and economy; followed by elucidatory and evaluator comment and a final summary statement.

The part of most types of research reports is identical. These normally include a title page, preface, a contents table sometimes a forward and a page of acknowledgements. These preliminaries are followed by the main body text, which usually includes following chapters:

Chapter I : *Introduction*: It provides the statement of the problem, scope, significance, etc.

Chapter II : *Theme of the Philosophy*: It gives an analysis of philosophical aspects: metaphysics, epistemology, ethics, universe and man, etc.

Chapter III : *Philosophy and Aims of Education*: It determines the aims of education on the basis of epistemology, metaphysics and moral philosophy.

Chapter IV : *Philosophy and Methods of Teaching*: Contribution to teaching methods are reported.

Chapter V : Philosophy and Curriculum Construction: Under this chapter principles and forms of curriculum for different stages are presented.

Chapter VI : *Philosophy arid Educational Administration*: Form of educational administration is reported or basis of philosophical aspects.

Chapter VII : *Philosophy and Educational Programme*: Different educational programmes according to the philosophy are reported in this chapter.

Chapter VIII : *The Conclusions, Generalization and a Summary*: Under this chapter findings of the study are reported systematically and summary of the work is also given.

After the main body of the report, list of references appendices and index wind up the textual labour. References in the body of the text are given in the footnotes or altogether at the end in the listed references. The format and get-up are a matter that contributes to the aesthetic value of a report.

Philosophical and Historical Types of Research

Both types of research have many points in common and primarily they are very erudite pursuits having mainly to do with study of relevant literature, which is invariably quite considerable.

These two types of approach are complementary to one another rather than contradictory to each other. If history clothes the dry bones of facts with the flesh and blood of a vanished but once vital reality, philosophy must breathe life and spirit into this resurrected apparition. This amounts to capturing the moral and spiritual heartbeat of a generation, or of a personality long dead.

There are however certain differences between the two methods. In philosophical research our interest is primarily in idea and theory or principles underlying educational practices rather than in a particular past with its 'ineradicable temporal locus'. The historical truth is always concrete and particular; philosophy seeks the principles of things that constitute education. Philosophical insight must of necessity generalize and seek out preference the essence of things the ideological of concrete fact.

Philosophy offers more freedom to the worker than even history in this area and the change subjectively is a good deal more justified. The historical interpretation confines to fact whereas a philosopher will usually go beyond for its interpretation. Philosophical research is free of a limitation whereas historical research is not. Historical research is entirely dependent on the existence of pertinent traces whereas philosophical research is dependent on existing human life. Themes of philosophical research are relatively easier.

Differences Between Scientific and Philosophical Method of Research

Scientific Method	*Philosophical Method*
1. The purpose is to analyse the nature of the phenomena and formulate theory and principles.	1. The focus is to establish reality of the phenomena through thought process.
2. It is highly quantitative method of research. The measurement and observation are main devices for collection of evidences.	2. It is qualitative method of research. The available and reliable information is main source of data.
3. It is an empirical inquiry into a problem or a phenomena.	3. It is a logical inquiry into a phenomena.
4. An experimental method is employed in the scientific research.	4. Non-scientific or supra experimental or esoteric method is used.
5. It mainly deals the means and method.	5. It deals the ends and ultimate goals.
6. It concerns with the awareness and development of cognitive conative and psychomotor aspects.	6. It concerns with realization of truth, beauty and goodness, i.e. reality.
7. It relates to the human-behaviour not a whole but some aspects.	7. It relates to humanity and to study life as whole.
8. It utilizes the main's perceptions and observations to know about phenomena.	8. It utilizes human mind and thought process (experiences) to establish the reality of phenomena.

Scientific Method	*Philosophical Method*
9. It is designed to verify hypotheses.	9. It is planned to prove or disprove propositions.
10. It culminated man's observations so that he will be able to generalize.	10. It culminates man's unending quest of certainly.
11. It is very much concerned with the utility of phenomena.	11. It is above the utility of phenomena.
12. It is authentic or analysing cause-effect relationship among variables.	12. It is authentic philosophy to establish causality.
13. It concerns with the analysis of characteristics of phenomena.	13. It concerns with establishing reality to its existence and the experience of existence.
14. It attempts to study the effectiveness of practicability of phenomena.	14. It attempts to establish the value and importance of the phenomena.
15. Its findings have high internal validity	15. Its findings have high external validity.
16. Scientific studies attempt to impose control over the situation to analyse true cause-effect relationship.	16. It provides the freedom for the thought process and to interpret the situation by using judicious insight.
17. It is highly objective method of research.	17. It is highly subjective method of research.
18. It employees elaborate technique and design of experiments.	18. It does not require any elaborate technique of research.
19. It has the limited scope of research in education.	19. It offers endless scope for research in education.
20. It attempts to answer the question how? e.g., How should arithmetic be taught effectively? Compare the effectiveness of two methods.	20. It attempts to answer the question why? e.g., why arithmetic should be taught? Or should arithmetic be taught at all.

There is more continuity and stability in philosophical research than in scientific research. Philosophical remain analyse the same, in one from or another.

EXERCISES

1. Define the term philosophy and differentiate between philosophy and Darshan. Enumerate the need of philosophy.
2. What do your understand by philosophical inquiry? Differentiate between scientific inquiry and philosophical inquiry of research.
3. Explain the following terms: Philosophy of education, educational philosophy and philosophical foundations of education. Emphasis the functions of educational philosophy.

4. Describe the need and scope of the philosophy of education.
5. Enumerate the role of philosophical research in education and describe the major approaches in philosophical research.
6. Describe the procedure of philosophical research in education.
7. Differentiate between scientific method and philosophical method of research.
8. Enumerate the similarities and differences between historical and philosophical research.

Chapter 9

Experimental Method

Experimental method is a scientific method. It is oriented to the future in the sense that the researcher is seeking to evaluate something new. It is a process of contribution to the already acquired fund of knowledge. Thus, the experimenter operates under the basic assumption that the research situation he wishes to evaluate has never existed and does not now exist. Situation here means in the sense of a programme, curriculum or method for organizing class, as well as a 'situation' created to test.

According to Jahoda: It is a Method of Testing Hypothesis

The purpose of experimentation is to derive verified functional relationships among phenomena under controlled conditions or more simply, to identify the conditions underlying the occurrence of a given phenomenon. From an operational point of view, it is a matter of varying the independent variable in order to study the effect of such variation on the dependent variable. For example, the investigator might vary the size of the print and appraise the effect of such manipulation on reading speed. Actually, what we know about our environment comes from observation, and all research is concerned with the observation of phenomena and the generalization of these observations into certain functional relationships whose internal validity can be tested. Experimentation simply enables us to improve the conditions under which we observe and, thus, to arrive at more precise results. This is the essence of the scientific method.

MEANING AND DEFINITION OF EXPERIMENT

There are many views about the experiment, given by different researchers. They are as follows:

"An experiment usually consists in making an event occur under known conditions whereas many extraneous influences as far as possible are eliminated and close observation is possible so that relationship between phenomena can be revealed."

– William I.B. Beveridge

"An experiment is an observation under controlled conditions."

– F.S. Chapin

W.S. Monro and M.D. Engelhart define term 'experiment' in their words

"Experimentation is the name given to the type of educational research in which the investigator controls the educative factors to which a child or group of children is subjected during the period of inquiry and observes the resulting achievement"

John W. Best has defined experiment that

"Experimental research is the description and analysis of what will be or what will occur, under carefully controlled condition."

"An experiment is a question framed on the basis of what is known and addressed to nature to elicit further knowledge. It, thus transcends mere observations or collection of materials; it is consciously directed, purposeful observation."

– E.B. Wilson

According to Johada and others: "It is a method of testing hypothesis"

"Experiment is the proof of a hypothesis which seeks to make up two factors into a casual relationship through the study of contrasting situations which have been controlled on all factors the one of interest, the latter being either the hypothetical cause or the hypothetical effect."

– Ernest, Greenwood

"The essence of an experiment may be described as observing the effect on a dependent variable of the manipulation of an independent variable."

– Festinger

According to W.S. Monore

"Experimentation is the name given to the type of educational research in which the investigator controls the educative factors to which a child of group of children is subjected during the period of inquiry and observes the resulting achievement.

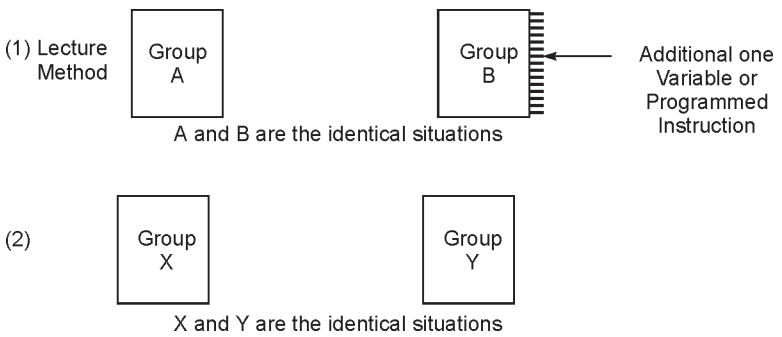
THE BASIC ASSUMPTIONS BEHIND THE EXPERIMENT

(*Law of Simple Variable*)

Experimental research in the original form is based on the assumption of the established Law of Single Variable by J.S. Mill: If two situations are similar in every respect, and one element is added or subtracted from one but not the other, any difference that develops is the result of the operation of that element added or subtracted.

It means if two situations are identical in all respects the addition or subtraction of one variable contributes the differences or change or effect in two situations than the difference or effect is said to be the cause of the single additional or the single variable.

For example:



If the additional or subtracted variables causes the difference between the two identical situations then it may be attributable to the variable.

CONCEPT OF CAUSE AND EFFECT

The main focus and scientific study is to analyse the functional relationship of the variables. The functional relationship refers to the cause and effect relation between the variables.

The cause and effect relationship can be studied by applying the 'Law of Single Variable'. A researcher wants to study the effectiveness of new teaching strategy, i.e., programmed instruction. For this purpose two equivalent groups are selected, one group will be taught through new strategy or programmed instruction and another group with lecture method. Same content will be taught and same criterion test or achievement test will be administered on both groups. The performance of programmed instruction group is significantly higher than that of lecture method group. It may be concluded that programmed instruction strategy is effective than the lecture method, because the performance of experimental group is caused by the new strategy of teaching or programmed instruction treatment.

MEANING AND DEFINITION OF VARIABLE

On the experimental study the main functioning proceeds around the variables. To see the cause and effect is the main focus of this study and the further question "Of what" gives the word 'Variable'. To see the effect of these variables is the purpose of experimental study.

Kerlinger says: "Variable is a property that take on different value." A variable is any feature or aspect of an event function or process that, by its presence and nature, affects some other event or. process, Which is being studied.

TYPES OF VARIABLES

The variables can be classified in various ways but four types of variables are employed in conducting an experiment in education:

1. Experimental Variable or Independent Variable.
2. Controlled Variable.
3. Criterion Variable or Dependent Variable.

1. Experimental Variable

An experiment is conducted to examine the effect of a variable or treatment which is known as experimental variable. The main attention is given in the experiment to observe its effect. The programmed instruction strategy may be an experimental variable.

2. Controlled Variable

The effectiveness is the relative term, therefore the effectiveness of an experimental variable is examined by comparing with other variable which is known as controlled variable. The effectiveness of programmed instruction strategy is studied by comparing with the lecture or traditional method of teaching. The lecture method is the controlled variable. The control group subjects should not get the exposure of the experimental variable.

3. Criterion Variable or Dependent Variable

The basis on which the effectiveness of the experimental variable is established or studied is knows as the criterion variable. The achievement may be the criterion or dependent variable. The learning outcomes

or achievement or change of behaviour are usually the criterion variable in education or psychology. If we want to study the effectiveness of schedules of reinforcement, it will be examined in terms of student achievement through different schedules of reinforcement. The student achievement is the criterion variable.

4. Intervening Variable

There are a number of abstract variables in educational experiment which intervene the effect of experimental variable on criterion variable. The learners attitudes, motivation and learning process are the intervening variables. A researcher should be careful about intervening variables in conducting an experiment to obtain the true effect of the treatment.

Experimental Group: An experiment is conducted on sample or group of subjects. The group which is assigned to the experimental variable or treatment is known as experimental group.

Controlled Group: The effectiveness of experimental variable is examined by comparing with controlled variable. The group which is allotted to controlled variable is termed as controlled group.

EXPERIMENTAL CONTROL

The main important problem of an experiment is the experimental control. For an accurate conclusion it is essential that all variables except experimental variable, should be controlled. It should only be in a functional situation.

According to McGuigan: The word 'Control' implies that the experimenter has a certain power over the conditions of this experiment. He is able to manipulate variables in effort to arrive at a sound conclusion.

NEEDS OF CONTROL

1. For the internal validity of result.
2. To know the effect on situations by changing them.
3. To make scientific observation.
4. To make prediction.

The control means to hold over the situations in this way that a change at any time can be brought about and could control the effect.

CONTROL OF WHAT AND HOW

Researcher needs to study the effect of the independent variable. For this he has to control all the other relevant variables which effect the activation of experimental variable.

Researcher has to design and conduct the experiment in such a way that the experimental group should not be exposed other than experimental variable or the treatment.

CHARACTERISTICS OF AN EXPERIMENT

The purpose of experimentation is to identify functional relationships, among phenomena through staging the occurrence of certain outcomes under controlled conditions designed to prevent the confusing

effects of the operation of extraneous factors. Experimentation can be considered a technique of deliberately staging a situation designed to force nature to provide a "yes" or "no" answer to a specific hypothesis concerning the phenomena under discussion.

Experimentation is to provide a meaningful solution to a problem, it is essential that the experiment contains, within itself, the means for answering its own questions-that is, the experiment must be self contained. This, in turn, calls for the satisfaction of three basic and inter-related conditions-control, randomization and replication. Unless these conditions are, fulfilled, the experiment cannot be interpreted, for it cannot eliminate the possibility that the results obtained were caused by factors other than that under investigation. More specifically the experiment must provide the basis for calculating the probability that the phenomena which did occur was the result of the experimental factor rather than of the operation of extraneous factors.

The experimental method in educational research is the application and adaptation of the classical method of the science laboratory. It is the most exacting and difficult of all methods and also the most important from the strictly scientific point of view. The main features of experimental method are:

1. Its basic assumption rests on J.S. Mill's Law of Single Variable which states that if two situations are similar in every respect, and one element is added to or subtracted from one but not the other, and difference that develops is the result of the operation of that element added or subtracted. Experimentation, therefore. involves an attempt to control all essential factors save a single variable which is manipulated with a view to determining and measuring the effect of its operation. This procedure is distinctly different from the historical and the normative survey methods.
2. Now a frequently used procedure in educational research it has been applied with considerable success in the classroom where within certain limits, significant factors or conditions can be controlled.
3. Since in the field of education complex human beings are the subjects and since it is unlikely that all variables can be successfully controlled, experimentation is not a perfectly precise method. The experimental findings in education are somewhat exact because some variables (like teacher's enthusiasm for or competence in using a particular method or material, regularity of attendance, mental or emotional state of the child determined by a number of factors) are extremely difficult or even impossible to control. The basic condition of other things being equal it is difficult of fulfillment in educational research.
4. Most classroom experiments have attempted to eliminate one or more of the variables: age, achievement, intelligence, or reading ability, social status and race, etc. Experiments often have to be conducted using intact, existing groups, trusting that the variables not controlled are irrelevant or insignificant for the purpose of study. The control group and the experimental group are never as identical as they ought to be for an exact experiment.
5. The concepts of educational experimentation has developed since the beginning of the last decade of the 19th century and interest in the experimental method of research in education has made rapid progress in the last fifty years or so.
6. Experimentation in education has been put to various uses, main among which are:
   (*i*) to determine and evaluate the adequacy and effectiveness of educational aims and objectives through the measurement of outcomes;
   (*ii*) to serve as basis for the formulation, execution and modification of educational policies and programme; and

(*iii*) to ascertain the effect of any change in the normal educational programme or practices.

7. Experimental studies in education never strictly empirical, can yet approximate strictly empirical research in many areas. For example, the teaching of spelling through different methods, difference between the effect of the authoritarian and democratic set up in education, and the possibility and extent of one subject improving achievement in another, are problems which have been handled in a scientific way through the experimental approach. But there are areas where a strictly empirical approach is impossible. For example, in finding out whether centralization of educational administration produces better results than local freedom, in deciding if co-education is preferable to separate schools for boys and girls, and in establishing whether certain achievements of education stay when formal schooling stops, nothing more. In such areas and for solving such problems where we cannot experiment we look out for cases where education goes on under different conditions. We let the reality experiment for us and just watch and study the results objectively.
8. All experiments in education are ultimately experiments with children, i.e., human beings, who for ethical reasons must not be subjected to conditions that may harm them. The popular slogan "No experimenting with children" may not be wholly justified, but there certainly are boundaries of a moral character for experimentation which must not be infringed.
9. Another difficulty, in principle at least, arises from the fact that educational experiments are carried through with human beings and affect mental processes and attitudes. Gestalt psychology are related research have shown that the introduction of any specific influence, however well and exactly defined, intended to change one specific type of mental process or attitude-well change the 'whole field' of mentality, often in aspects and ways that especially he control of the experimenter.

THE STEPS OF THE EXPERIMENTAL METHOD

The steps of the experimental method are essentially those of the scientific method. For the sake of clarification, they may be listed as follows:

1. *Selecting and delimiting the problem*: The problems amenable to experimentation generally can, and should, be converted into a hypothesis that can be verified of refuted by the experimental data. The variables to be investigated should be defined in operational terms for example, the scores on a test of acceptable validity.
2. *Reviewing the literature.*
3. *Preparing the experimental design*: While it should also include a clarification of such basic aspects of the design as the place and the duration of the experiment, this section should place primary emphasis on the questions of control, randomization, and replication. Because of the complexity of an experiment, it is generally advisable to conduct a pilot study in order to ensure the adequacy of the design.
4. *Defining the population*: It is necessary to define the population precisely so that there can be no question about the population to which the conclusions are to apply.
5. *Carrying out the experiment*: It is necessary here to insist on close adherence to plans, especially as they relate to the factors of control, randomization and replication. The duration of the experiment should be such that the variable under investigation is given sufficient time to promote changes that can be measured and to nullify the influence of such extraneous factors as novelty.

6. *Measuring the outcomes*: Careful consideration must be given to the selection of the criterion on the basis of which the results are to be measured, for the fate of the experiment depends in no small measure on the fairness of the criterion used.
7. *Analyzing and interpreting the outcomes*: The investigator is concerned with the operation of the factor under study. He must be especially sensitive to the possibility that the results of his study arose through the operation of uncontrolled extraneous factors. He must further exclude, at a given probability level, the possibility that his experimental findings are simply the results of chance. In no other area of educational research is the need for competence in statistical procedures so clearly indicated as in the analysis of experimental data as the basis of their valid interpretation. Of course, statistics cannot correct fulfills in the design or overcome inadequacies in the basic data. The investigator must recognize that statistical tools do not relieve the scientist of his responsibility for planning the study for controlling extraneous factors and for obtaining valid and precise measurements. It can also be argued that there is limited justification for high-powered statistical refinement in the early exploration of a problem area or in instances where the data involved are essentially crude and imprecise.
8. *Drawing up the conclusions*: The conclusions of the study must be restricted to the population actually investigated and care must be taken not to over generalize the results. The results also pertain only to the conditions under which they were derived and since control may have distorted the natural situation care must be taken to restrict the conclusions to the conditions actually present in the experiment. The investigator must not forget that his conclusions are based on the concept of probability but especially he must not fail to recognize the limitations underlying his conclusions and/or the special conditions that restrict their applicability.
9. *Reporting the result*: The study must be reported in sufficient detail so that the reader can make a judgement as to its adequacy.

CLASSIFICATION OF EXPERIMENTS OR EXPERIMENTAL PROCEDURES

Experimental studies can be variously classified on different bases. The usual bases observed for classification of experiments are:

1. *Type of control*: Scientific or practical, formal or informal, actual or inferred.
2. *Means of approach*: Analytical, comparative, quantitative or qualitative.
3. *Place where conducted*: Laboratory, field or classroom.
4. *Grouping of subjects*: In groups or individually.
5. *Treatment of subjects*: In groups or individually.
6. *Function or purpose*: To study direct effects indirect effects or causes.
7. *Time involved*: Long or short duration.
8. *Sponsorship or investigation agency*: Independently or cooperatively but an individual or an institution.

Among the several bases of classification listed above the most significant, perhaps is the one which takes into account the grouping of subjects because the design of an experiment is largely determined by this factor.

Experimental designs vary in complexity and adequacy, depending on such factors as the nature of the problem under Investigation, the nature of the data, the facilities for carrying out the study, and

especially, the research sophistication and competence of the investigator. Although there are a number of combinations of the various experimental procedures.

There are three basic procedures in the experimental method :

1. Single individual or single group experimentation.
2. Parallel or equated groups experimentation, and there are four ways for equating the groups.
   (*a*) Randomization for equating groups.
   (*b*) By comparing mean scores of the two groups.
   (*c*) Matched pairs method for parallel groups.
   (*d*) Co-twins method for equating groups.
3. Rotational procedure. It is of two types:
   (*a*) Single group rotation, and
   (*b*) Parallel or equated group rotation.

There are three basic types of errors which influence in an experiment in field of education. These are sampling error or S-error, Replication error or R-error and General error other than S and R or G error. The above procedures of experiment have the focus to control the sampling error only. E.F. Lindquist developed Basic Experimental Designs for eliminating these three basic types of errors which are as follows:

1. Simple Random Design.
2. Levels x Treatments Design,
3. Subjects x Treatments Design,
4. Random Replication Design,
5. Group Within Treatment Design, and
6. Factorial Design.

These designs have been discussed in the following chapter in detail and procedures of experimental have been described in the following paras:

These procedures differ in the particular manner in which they attack the problem, in the degree of accuracy with which they meet the criteria of control, randomization and replication, and, of course, in the adequacy of the answers which they are capable of providing.

1. The Single Individual or One-Group Procedure

The single individual or one-group experiment is the most elementary and least rigorous design. It consists of comparing the growth of a single group under two different sets of conditions-that is, of subjecting the group successively to an experimental and to a control factor for equivalent periods of time and then comparing the outcomes. The procedure might be listed as follow:

1. Test the group; introduce method A; test the group again; and note the gains.
2. Allow for a period of transition.
3. Test the group again; introduce Method B; test the group once more; note the gain.
4. Compare the gains in 1 and 3.

This experimental design has a number of limitations that need to be clearly recognized. On the favourable side, it permits an experiment to be conducted by a teacher in his own classroom without assistance, and, on the surface, since the same group and the same teacher are involved, it seems to

make a fair attempt at equating the factors of the ability and background of the subjects and the general characteristics of the experimental situation.

The steps of this procedure are:

1. One group is measured under the referred factor variable (V).
2. Except independent variable (Ex. V) all other variables are kept as they are.
3. Exp. V. is used for a particular time.
4. Group is measured for study the effect or changes in Depe. V. by Exp.V.
5. One by one other variables are included for deterring the effect.

Advantage: The following are the main advantages of this procedure:

1. This simple experimental design is more useful than others.
2. The planning and activation of this is easy and simple.
3. Equalization of group or changing is not needed.
4. It is applicable in classroom.
5. It works as a stimulus for better teaching.

Limitations: The following are the limitations of this procedure:

1. Influence of growth and maturity.
2. Influence of transfer or training.
3. Influence of experiment and knowledge.
4. Influence of skill factor and practice.
5. Influence of attitude or method in between two experimental situation.
6. Difference in the speed of learning.

The parallel or equated group procedure is an improvement over the single individual and single group procedure.

2. The Parallel or Equivalent Group Procedure

A more adequate experimental design is the parallel or equivalent group technique in which the relative effects of two treatments are compared on the basis of two or more groups, which are equated in all relevant aspects. This is essentially the implementation of Mill's common of difference. In an educational experiment, the groups being compared generally are equated on chronological age, 10, motivation, sex, general scholarship, general background, and any other factor considered relevant to the problem under investigation. The basic design of parallel group experimentation might be represented as follows:

Experimental group	*Control group*
1. Pre-test	Pre-test
2. Experimental factor	Control factor
3. Final test	Final Test
4. Comparison of gains difference	

Thus, the main steps in the parallel group method are as follows:

1. Securing equivalent groups,
2. Applying the experimental factor,

3. Comparing the results, and
4. Interpreting and reporting the results.

The initial step of securing equivalent groups is a crucial one due to the varying degrees of inherited and acquired characteristics in the members of any group. The control factors usually considered are:

1. Chronological age,
2. Sex,
3. Race,
4. Physical condition,
5. Intelligence,
6. Previous achievement,
7. Study habits, and
8. Personality trait.

The last two, obviously, do not lend themselves to objective measurement and so are less reliable factors than the earlier ones, although no less important.

Among the many methods of equating groups for experimental purposes, the following devices are frequently employed:

(a) Chance or random selection.
(*b*) Equating on the basis of mean scores and standard deviation.
(*c*) Equating by matched pairs.
(*d*) Equating by co-twin methods.

Advantages: It has the following main advantages:

1. The main advantage of this type of experimental design is that it is free from the weaknesses of the one-group method.
2. Both the control and the experimental factor or factors are applied simultaneously on different groups so that the difficulties due to maturation and practice effect, etc., do not arise.

Limitations: The equated groups procedure has the following limitations:

1. This method suffers from the difficulty of equating groups and controlling significant variables.
2. These are several administrative problems for selecting subjects from schools.
3. The sampling error can not be minimized by this procedure.

3. Rotational Groups Procedure of Experiment

Rotational experiment is designed with a single group or with equated two group's procedure. The experimental and controlled groups are rotated in different cycles to different treatments. The procedure of rotation eliminates the sampling error because the same subjects are kept in controlled and experimental variables. Therefore, this technique is an improvement over the earlier two procedures.

(*a*) Single Group Rotation: In this procedure same group is kept in controlled and experimental situations successively in the first cycle. In the second cycle the same group is assigned in experimental and controlled situations

Cycle	*Experimental situation*	*Controlled situation*
I Cycle	Group All	Group A12
II Cycle	Group A22	Group A21
Mean Scores	Me	Mc

The significance of mean scores is tested and conclusions are drawn about the effectiveness.

(*b*) Parallel or Equated Two Groups Rotation: Under this procedure two groups are equated on some criterion. There are two groups A and B. Group A is kept in experimental factor and Group B in controlled factor in cycle. In the cycle Group B is kept in experimental factor and Group A in controlled factor.

Cycle	*Experimental*	*Factor*
I Cycle	Group A	Group B
II Cycle	Group B	Group A
Mean Scores	Me	Mc

The significance of mean scores is tested and conclusions are drawn for the effectiveness of experimental factor.

If more than two factors have to be made the subject of study, more than two groups will have to be employed, and number of cycles, at least equal to the number of groups employed, have to be observed.

Thus, the rotational method involves the rotation of instructional factors of the experimental and control groups at equal intervals. The measurement of influences is done factors-wise by adding up the results after the introduction of individual factors. More than two groups, more than two factors and more than two cycles will be handled in the same way.

The rotation group method is used to secure control of pupil factors when groups cannot be thoroughly equated. It also neturalizes the teacher-variable. In general, it overcomes the chief weaknesses of both the one group and the equivalent group methods. Since in the rotation group design each variable is applied to each group, it is not necessary that the groups be exactly equated. Of the three designs of educational experimentation, this is the most valid but the most complicated too.

CHARACTERISTICS OF A GOOD EXPERIMENTAL METHOD

These characteristics are classified into two categories:

A. General Characteristics and B. Specific Characteristics.

A. General Characteristics of an experimental method

The following are the general characteristics.

A_1 Bias free estimation of true effect,

A_2 Precision of the estimates with a quantitative index,

A_3 The testing of clear specific hypothesis of different intention etc., and

A_4 Efficiency in the sense of securing maximum results at minimum.

B. Specific Characteristics of an experimental Method

The following are the specific characteristics:

B_1 It emphasizes objectively and accuracy in the collection of the data and treatment part of it.

B_2 It emphasizes control of conditions and the experimentation of certain variables in controlled conditions.

B_3 It sets out the relationship between the phenomenon and this relationship is more or less of the casual type.

B_4 It uses standardized tool for experimentation and makes the evidences very much objective.

B_5 The sample is selected with great precaution and every care is taken to safeguard extraneous factors.

B_6 It leads to the testing of a specific hypothesis and experimental evidences so called as to reject or retain the hypothesis.

B_7 The laws, postulate and theories of education are developed mostly through experimental methods. It allows for precision and definiteness (exactness) in the findings and their analysis and treatment through measurement. The hypothesis is rejected or retained, measurement through standardized test and tools of research.

THE APPLICATION OF EXPERIMENTAL METHOD IN THE FIELD OF EDUCATION

Area of experimental method is in the teaching methods and in instructional material etc.

1. To find out the efficiency of different methods teaching in one subject in class-room.
2. To test the effectiveness of different type of instructional material used in class-room situation.
3. School plant experiment, i.e. to improve the school plant to improve the tone of the school.
4. The curricular, different type content can be tried out on the student, Text books can be written with the help of experimental method that will be effective and useful. What type of content should be included in the text-books etc.
5. Administrative problem, this will be included in discipline problem of human relation. A student can be discriminative in school of star of the school. The traits of the students can be measured.

PRECAUTIONS TO BE TAKEN IN EXPERIMENTATION

The following precautions are to be observed in experimentation:

1. Purpose of experiment should be defined clearly in advance.
2. Experiment control and criterion variables should also be defined clearly.
3. Great precautions be taken for the effect of intervening variables.
4. Sample should be selected carefully and appropriate sampling techniques should be used.
5. Pre and post test should be given in the experimental situation.
6. Same criterion test should be used as pre and post test.
7. In designing and experiment the following things should be kept in view:
    1. Plan (Layout).
    2. Procedure.
    3. Time.
    4. Cost.

EXERCISES

1. Define the term ‘Experiment’. Enumerate the basic assumption of an experiment and explain the ‘Law of Single Variable’.
2. Explain and illustrate the following types of variables: (*a*) Experimental variable (*b*) Controlled variable (*c*) Intervening variable (*d*) Moderator variable.
3. Enumerate the characteristics and uses of an experiment in educational research.
4. Indicate the steps of the Experimental Method.
5. What are basic procedures employed in the experimental method? Describe the rotational procedures and mention situations in which this can be used effectively.

Chapter 10

Case Study Method

Case study is both method and tool for research. Case study leads to very novel idea and no longer limited to the particular individual. In case study investigator tries to collect the bits in support of proposition. One case study if we take specific than prediction value is less while if the case is the representative sample then it has high prediction value. Case study methodological is not longitudinal study but it depends on the methods of information about the individual as far as possible.

Therefore, case study is conducted only for specific case. It requires personal observation, by or objective method. Actually case study means a study in depth. Here depth means to explore all peculiarities of case. Case study is the intensive study of a phenomenon, but it gives subjective information rather than objective. It gives a detailed knowledge about the phenomena and not able to generalize beyond the knowledge. In physical science every unit is the true representative of the population, but in education and the units may not be true representative of the population. There are individual differences as well as intra- individual differences. Therefore, prediction can not be made on the basis of knowledge. No statistical inferences can be drawn from the exploration of a phenomenon.

Here case does not necessarily mean an individual. Case means an unit, it may be an institution or a nation, or religion or may be an individual or a concept.

Thus, case study refers to

- **Close study of an unit,**
- **Deep study,**
- **Cumulative study, and**
- **Clinical study.**

The case study is mostly done in police inquiry to investigate the case. The purpose is to find out the facts about the case so that true culprit would be punished. In research case study has entirely different purpose. The main purpose of case study is the development of case on the basis diagnosis which is done on the post records of the case. It establishes the cause and effect of relationship.

DEFINITION OF CASE STUDY

The case study or case history method is not a newer thing, but it is ‘a liner descendent of very ancient methods of sociological description and generalization namely, the ‘parable’, the ‘allegory’, the ‘story’ and the ‘novel’.

Case study is based on intensive study of the comparatively fewer persons, sometimes confined to a very small number of cases only. P.V. Young wirtes :

“A fairly exhaustive study of a person or group is called a life of case history.”

Thus, the case study is more intensive in nature, the field of study is comparatively limited but has more of depth in it. And here the unit of study is also unlimited. P.V. Young again writes:

"Case study is a method of exploring and analyzing the life of a social unit - be that unit a person, a family, institution, culture group, or even an entire community."

Good and Scates have defined comparatively 'case study' as follows:

"The essential procedure of the case-study method is to take account of all pertinent aspects of one thing or situation, employing as the unit for study an individual, an institution, a community or any group considered as an unit. The case consists of the data relating to some phase of the life history of the unit or relating to the entire life process, whether the unit is an individual, a family, a social group, an institution, or a community. The complex situation and combination of factors involved in the given behaviour are examined to determine the existing status and to identify the casual factors operating."

The foregoing definitions of case study may be rendered concerete by citing the titles of selected works that illustrate the application of this investigational procedure to individuals, social institutions or agencies and communities or culture groups.

Some writers have made a distinction between the terms case. study, case work and case method. As defined above case-study means intensive investigation of the particular unit represented. Case work refers especially to the developmental adjustment, remedial or corrective procedures that appropriately follow diagnosis of the causes of maladjustment or of favourable development.

CONTRIBUTIONS OF CASE STUDY

The unique contribution of case study to general knowledge has been outlined by Olson under the following six headings:

1. Tabulation of case under significant categories as a means of communication to professional workers, the nature of the problems involved, for example, classification of the cases referred to a bureau of juvenile research in items of source of reference, age, sex, race, problem, intelligence, school grade, economic status, and interrelations between certain factors.
2. Evaluation of programme by studying the subsequent history of the person affected; for example, to follow up habit-clinic children who manifested delinquency problems before the age of ten years, through securing judgements on improvement from parents, teacher, hospital and agency.
3. Study of social and institutional group patterns existing in families, classes, schools and communities.
4. Provision of case materials for institutional purposes in professional courses.
5. Illustration and validation of statistical result, as in supplementing statistical findings on twin resembles by detail case histories.
6. Formulation of generalizations on the basis of the body of knowledge that results through accumulation of published reports of cases of particular types, as in medicine and in certain social, psychological, and educational areas.

OBJECTIVES OF CASE STUDY

The case study has the following four main objectives:

1. Clinical purpose, (dealing with a patient).
2. Diagnostic purpose, (educational situation to provide the remedial instruction to poor students).
3. Fact-findings about psychological or educational problems.
4. Supplementing other information. It may be a follow up work. Phases of Case Study.

A Case Study is Conducted into Three Phases

1. Retrospective phase refers to the past records of the case completely which is used in diagnosing the case.
2. Prospective phase refers to the present status of the case, which is helpful in understanding the case. The suggestions and remediation can be offered to the case.
3. Conspective phase refers to the future development and improvement of the case which is also employed to examine the effects of the remediation given to the case.

TYPES OF CASE STUDY

Six types of case studies are conducted which are as follows:

1. A group or a community case study,
2. Casual comparative studies,
3. Activity analysis.
4. Content or document analysis,
5. A follow-up study, and
6. Trend studies.

1. Community Studies

The community study is a careful description and analysis of a group of people living together in a particular geographic location in a corporative way. The community study deals with such elements of the community as location, appearance, prevailing economic activity, climate and natural sources, historical development, how the people live, the social structure, goals and life values, an evaluation of the social institutions within the community that meet the human needs etc. Such studies are case studies, with the community serving as the case under investigation.

The community studies made by Robert and Helen Lynel and their associates at Muncee, Indiana, are well known. The first reported in the volume 'Middletown' in 1929 and the second, 'Middletown in Transition' in 1937.

2. Casual Comparative Studies

Another type of study seeks to find the answers to the problems through the analysis of casual relationship. What factors seem to be associated with certain occurrences, conditions or types of behaviour? By the methodology of descriptive research, the relative importance of these factors may be investigated.

For example, studies of juvenile delinquency may compare the social educational background of delinquents and non-delinquents. What factors were common to the delinquent group? What factors were common to the non-delinquent group? Any factor common to one group, but not to the other, might serve as a possible explanation of the underlying causes of delinquency.

3. Activity Analysis

The analysis of the activities or processes that an individual is called upon to perform is important, both in industry and in various types of social agencies. This process of analysis is appropriate in any field of work and at all levels of responsibility. In social system the roles of superintendent, the principal, the

teacher and the custodian have been carefully analyzed to discover what these individuals do and need to be able to do. 'The Common Wealth Teacher Training Study' (W.W. Charters and Waples, Chicago) made under the direction of Charters and Waples described and analyzed the activities of several thousand teachers, and searched previous studies for opinions of writers on additional activities in which classroom teacher should engage.

4. Content or Document Analysis

Content analysis, sometimes known as document analysis. deals with the systematic examination of current records or documents as sources of data. In documentary analysis, the following may be used as sources of data: official records and reports, printed forms, text-books, reference books, letters, autobiographies diaries, pictures, films and cartoons etc. But in using documentary sources, one must bear in mind the fact that data appearing in print are not necessarily trustworthy. The evaluation of documents used in descriptive research must be subjected to the same type of criticism employed by the historian.

This content or document analysis should serve a useful purpose in research, adding important knowledge to a field to study or yielding information that is helpful in evaluating and improving social or educational practices.

5. A Follow-up Study

A follow-up study investigates individuals who have left and institution after having completed programme, a treatment or a course of study, to know what has been the impact of the institutions and its programme upon them. By examining their status or seeking their opinions, one may get some idea of the adequacy or inadequacy of the institutes programme. Studies of this type enable an institution to evaluate various aspects of its programme in the light of actual results.

Dillon, Seagoe, Terman and Oden, Hanemann and West have made a follow-up study.

6. Trend Studies

The trend or predictive study is an interesting application of the descriptive method. In essence, it is based upon a longitudinal consideration of recorded data, indicating what has been happening in the past, what does the present situation reveal and on the basis of these data, what will be likely to happen in the future.

An excellent example of the trend study is presented in An Economic Portrait of Indiana in 1979. This type of study furnishes valuable data for furnishing programmes in whatever area they may be. These trends have important implications for college, officials, who must find ways of providing building and equipment, teaching staff and financial support for a greatly expanded programme of higher education. The commission on higher education anticipated that a flood of young people will be knowing at college and university doors and coming years.

CRITERIA FOR A GOOD CASE STUDY

The essential characteristics of a satisfactory case study include continuity, completeness of data, validity of data, confidential recording and synthesis that is scientific.

1. Continuity

There should be desirable continuity of information provided by two successive psychological examinations at any internal of a year, and by an elementary school record in relation to performance in high school.

2. Completeness of Data

In so far as possible, the potential range of data or information includes symptoms, examination results, (psycho-physical, health, educational and mentality) and history (health, school, family and school).

3. Validity of Data

A doubtful birth data may be verified through the Bureau of vital statistics, and employment record by reference to employers.

4. Confidential Recording

Educational workers have something to learn from medicine with respect to the confidential nature of professional records, the difficulties of individual teachers or pupils in relation to discipline, failure, achievement or mentality should be recorded as professional problems to be treated in a confidential manner.

5. Scientific Synthesis

This is an interpretation of the evidence that is more than a mere enumeration of data secured, it embraces diagnosis in identifying casual factor, and prognosis in looking toward treatment or developmental procedure.

If a case-study have all these characteristics, it will be an excellent study.

SOURCES OF CASE DATA

1. **Personal Documents:** Diaries, autobiographies, memoirs, letters, confession, etc.
2. Life history records.
3. **Related Persons:** Parents, neighbours, friends, teachers, etc.
4. **Official Records:** Baby books, school records, police courts, military organizations, clubs, institutions, etc.
5. The subject himself.

These sources have been defined in the following paras briefly.

1. Personal Documents

These possess the events of life of the subject and his reactions to them. They also represent a community of experience which helps to illuminate the writers' personality, social reactions, and philosophy of life.

2. Life Histories

It is a combination of facts and events. Because of thin aid in studying complex behaviour and situations in scientific detail, Burgess refers to the life history as "the social microscope".

Life history data are generally gathered through prolonged interviews.

3. Related Persons

Here with the altogether different of view of the informers, the different aspects of the subjects' life are attacked. Here 'trait acquaintancy' should be in the persons. Also, here chances of biases and misinterpretations are high, and it is the discriminating power of the researcher acting as a serve in separating the biased and factual facts.

4. Official Records

Most of the social and academic life is got from the official records.

5. Subject Himself

Sometimes of the patient or the subject may serve as the major source of data. But, however, here reliability of information is very low.

RATIONALE OF CASE STUDIES

Case studies generally involve the co-operation of a number of investigators pooling their resources toward the diagnosis, the prognosis, and perhaps the treatment of problem. In the guidance of a child who is displaying anti-social behaviour, for example, a team, consisting of the school psychologists, teachers, guidance workers, social workers, and other interested persons, pools its information and insights in order to gain an understanding of the case. Eventually a diagnosis is reached and remedial steps are prescribed. The latter validates the diagnosis; if the treatment alleviates the symptoms, it can be assumed that the source of difficulty has been properly identified, and that the problem is properly on its way toward disappearance. Conversely if the symptoms persist, it might be suspected either that the cause of the difficulty has not been properly identified or that an improper inference has been made about the treatment implied by the diagnosis.

In the social sciences, the problems of devising remedial producers and of implementing to the solution are also more difficult. Failure of the home to cooperate, for instance, may preclude a cure. Consequently, when treatment does not work it is difficult to know who is to blame for the failure or even to know if a failure is involved. Improvement frequently is slow, and even the most correct technique can aggravate the symptoms while reorganization is taking place, which may cause the person in charge to give up the treatment just as improvement is about to occur. It is also difficult to attribute success to any one cause. In reading, for instance, it is common to attribute the child's improvement due to the remedial procedures, when it may stem, in part at least from the greater attention the child is receiving. Thus, even when a cure is affected, the investigator may not have learned very much from a scientific point of view.

THE STEPS OF CASE STUDY

If it is to be accepted as a scientific technique, the case study must follow essentially the same steps and meet essentially the same criteria as do the other research methods. On the other hand, it presents a number of problems which are relatively unique, either in kind or in degree. These are probably best considered in connection with the steps through which such a study must proceed.

The following are the steps in the case study

Step 1 : Status of the Situation or Unit of Attention.

Step 2 : Collection of Data, Examination and History.

Step 3 : Diagnosis and Identification of Casual Factors.

Step 4 : Adjustment, Treatment and Therapy.

Step 5 : Follow up Programme.

1. Status of the Situation or Unit of Attention

The identification of the need-situation, aspect of behaviour, or phase of the life process as tile unit for study. For example, reading disability, habitual truancy, exceptional talent in music, superior mentality of a breadwinner out of a job. Typically, the case has centered on the situation as the unit of attention rather than on the individual or client as such, although the development of non-directive or client-centered therapy has introduced a new emphasis. As clearer insights and more refined techniques become a part of the equipment of investigators who use the case-study method and other research procedures, more penetrating discrimination is exercised in identifying cases for corrective or developmental attention. For example, it was only natural that the rather obvious maladjustment's of the physically handicapped received attention before cases of low mentality, special talents, and deficiencies in the school subjects were studied. Even more recent is the recognition in the types of social maladjustment, involving personality difficulties and behaviour disorders.

2. Collection of Data

Collection of data is the second step in the case study but with emphasis on the research for facts that may serve later as a basis for diagnosis or identification of the casual factors operating.

(*a*) Examination and History Outlines: The range of data useful in studying the circumstances associated with the particular situation of unit is well illustrated in an abbreviated outline for use in pedagogical case study.

1. Examination
   (*a*) Psycho-physical (*b*) Health (*c*) Educational (*d*) Mentality
2. Health History
3. School History
4. Family History and Home Conditions
5. Social History and Contacts.

(*b*) Personal Documents: As such documents as the life history, biography, auto-biography, diaries, and journals, letters records of dreams and expressive interview are valuable. Angell has analysed a variety of studies based on personal documents and identifies their contributions to the methodology of sociology in six categories.

1. Personal documents are collected with a view to the particular purpose of the study in hand, and the data therefore bear specifically upon the questions to be answered by the study.
2. Other types of data, particularly ecological and statistical are combined with the data from personal documents both to give more inclusive picture and to test of the reliability of documentary material.
3. There is increasing precision in conceptual analysis both before and after obtaining the personal documents.

4. Thorough-going attempts are made to use case studies for the prediction of human behaviour as in the effects of the impact of the depression upon family organization.
5. Hypotheses are so stated and methods sufficiently outlined in certain of these studies so that they can be checked by further investigation.
6. Logical and psychological procedures have been developed that should make more objective the use of the personal document and rid this method of much of the odium of inexactness associated with it.

(*c*) Life History: The life history differs from the usual autobiography in its emphasis on the natural history of the individual, his reactions to early social stimuli that have led to development of attitudes and values, evolutions of a philosophy of life, personal experiences, mental and social conflicts, crises, adjustments, accommodations and release of tensions in other words "a deliberate attempt to define the growth of a person in a cultural milieu and to make theoretical sense of it". In term of such definition the life-history view of social facts represents longitudinal rather than cross sectional observations.

A definite analysis of criteria considered indispensable for judging life-history technique has been outlined and illustrated at length by Dollard.

1. The subject must be viewed as a specimen in a cultural series.
2. The organic motors of action ascribed must be socially relevant.
3. The peculiar role of the family group in transmitting the culture must be recognized.
4. The specific method of elaboration of organic materials into social behaviour must be shown.
5. The continuous related character of experience from childhood through adulthood must be stressed.
6. The social situation must be carefully and continuously specified as a factor.
7. The life-history material itself must be organized and conceptualized.

(*d*) Autobiography, Biography and Diaries: Autobiography as historical narration is usually a relatively formal document, written with on eye on the judgment of the public, as is frequently true of the diaries of distinguished persons who have anticipated publication. Autobiography and biography are written in retrospect, while entries in a diary are recorded concurrently as experiences and events take place.

3. Diagnosis and Identification of Casual Factors

The structural pattern of diagnosis is the formulation of a theory or hypothesis of causation. From causation diagnosis looks towards the possibilities for growth and adjustment of the individual as a personality and as a social being who shares experiences with others. For example, a large number of children and youth require special diagnostic study in the solution of their educational and social problems. This group includes:

1. The mentally and physically handicapped.
2. Those who are maladjusted socially, morally, or emotionally.
3. Those who perform below their level of learning capacity.
4. Others whose latent talents and special aptitudes became the cause of inadequate stimulation, are never given expression.

From this point of view, diagnosis and treatment at times are interwoven, diagnosis frequently parallels treatment and does not simply precede adjustment procedures, however desirable an orderly sequence of steps many seem to the logical mind.

Criteria for Successful Diagnosis

The following are some of the criteria for successful diagnosis:

1. Must provide valid evidence of strength and weakness related to the objectives.
2. Must be reasonably objective to permit other competent investigators to reach similar conclusions in employing the same diagnostic technique.
3. Must be reliable, so that repeated diagnosis of other samples. from the same learners will give similar results.
4. Must be carried to a satisfactory level of specificity.
5. Must provide comparable data, measurement of progress at intervals requires equivalent test forms or procedures adequately standardized and controlled.
6. Must provide sufficiently exact data, for diagnostic purposes measuring instruments should be discriminating enough to indicate in units of weeks or months rather in semester of year.
7. Must be comprehensive or complete, in a particular subject deficiencies in memorization of facts frequently are analyzed, without determining the ability to use these facts in reflective thinking or problem solving.

Techniques of Diagnosis

Most of the data-gathering instruments and procedures named in discussing the preceding steps of case study contribute to diagnosis, in that the resulting data contain the clues for identifying casual factors. Techniques that have contributed especially to diagnosis include:

1. Tests of general intelligence, aptitude, personality and achievement.
2. Observation of the pupil's study habits. attitudes and 'reactions.
3. Analysis of the pupil's written work.
4. Analysis of the oral responses and reactions of the learner.
5. Objective devices to determine the nature and significance of faults, as illustrated by diagnostic handwriting charts.
6. The interview, and
7. Laboratory procedure.

Causation

In addition to the discussion of casual relationships in other chapters concerned with descriptive study, experimentation and historical research, a brief statement should be made with respect to identification of casual factors in diagnosis. The major factors associated with learning difficulty are physical, intellectual, pedagogical, emotional, social and environmental. To use difficulty in reading as an example. before locating the cause of the poor performance it may be necessary to study a wide range of factors: perceptual, motor, intellectual, linguistic, emotional and methodological. Causation may be primary, secondary, or contributory.

Rogers, "component-factor" method of diagnosis recognizes eight interacting forces and elements both within and without the individual child that must be considered in analyzing the behaviour of the problem-child-heredity, physical factor, mentality, family environment, economic and cultural forces, social factor, education and training outside the home, and the child's own insight into his present situation.

4. Adjustment, Treatment and Therapy

Functional Relationship Between Diagnosis And Adjustment: If the time and effort spent in reaching a diagnosis of casual factors are to be fully justified, an appropriate adjustment of conditions should be affected.

Rogers, analysis of the process of therapy, in terms of non-directive or client-centered concepts, included certain hypotheses that are based on an increasingly large body of experience.

1. Change or movement in therapy, as revealed in the type of verbal comment presented by the client; for example, from talk about his problems and symptoms, to insightful statements showing some self-understanding to relationship between his past and current behaviour, to discussion of new actions in accord with his new understanding of the situation.
2. Change in the client's perception of and attitude toward self: (*a*) sees himself as a more adequate person, with increased worth and greater possibility of meeting life (*b*) draws on more experiential data, thus achieving a more realistic appraisal of himself his relationships, and environment (*c*) tends to place the basis of standards of values within himself rather than in the experience or perceptual object.

5. Follow Up Programme

To complete the cycle of case study and case work, it is necessary to check the validity of the remedial treatment. After medication or surgery the physician follows the convalescence of the patient to determine whether recovery takes place. In instances of failure to make reasonable progress, a new diagnosis and a modified treatment may be required employed generality in case work.

Only through careful analysis is possible to identify the factor that produces the changes observed. A patient may recover because of strong constitution rather than as the result medicines administered.

Useful work has been done in following normal children through the school years and especially after leaving school to evaluate the effectiveness of the educational program in relation to civic and social efficiency and to vocational adjustment although such investigations have employed survey techniques more commonly than case study. A series of large scale investigations of bright children has used case study as one instrument in following the subjects over a period of years through school into maturity. However, much remains to be done byway of tracing the after school history of the physically handicapped. of those with personality and behaviour maladjustments of others who learn below capacity and yet others especially talented in a particular field, if appropriate adjustments are to be made in instructional and treatment programmes for such groups.

The Case Study of an Individual: A case study of an individual may take place ever a longer range of information. These are very significant incidents of his life which can be analysed and studied with a view to range of information regarding an individual through the study of facts relating to the individual. The case study of an individual means a range over the following sources:

1. Family history
2. Cumulative records, personal interview of the individual.
3. Personal habits.
4. Interviewing his associates and friends.
5. Individual school records.
   (*a*) Status in the class. .
   (*b*) Achievements.

(*c*) Kind of aspiration.
(*d*) Teachers attitude towards him.

6. Individual participation school playground and other places.
7. Individual and emotional adjustments against the class social groups.
8. On this basis the profile of the case is formed. The profile helps the investigators to diagnose and suggestions for remediation may be provided.
9. History of the case may be prepared.

CASE STUDY OF A GROUP

The whole group is studied with regard to the problem and special attention is paid to the problem of the group. These precautions are to be taken against the probability of the group being heterogeneous irrespective of the problem. Sociometry tool is generally employed to analyse the group dynamics and the following five major steps are used for case study of a group. The cycle of case work includes the following five steps:

1. Status of the situation.
2. Collection of data.
3. Diagnosis and identification of casual factors.
4. Step adjustments and therapy (remediation).
5. Follow up the adjustment of the programme or to evaluate the effectiveness of the programme.

THE CASE STUDY OF AN INSTITUTION

Here institution is unique as compared earlier to situation. This whole situation is studied to discover the significant facts related to the institution from its origin. The suggestions can be given for the improvement.

LIMITATIONS OF CASE STUDY

A case study generally suffers from the following limitations:

1. It is difficult to study objectively.
2. There is difficulty in formulation of hypotheses.
3. The data of informations are not collected in a systematic order.
4. The statistical inferences cannot be drawn.
5. Parents and relatives do not like to mention the weakness of the case or individual.
6. It is more time consuming and costly method.
7. It does not contribute to new knowledge and field studied.

COMPARISON WITH OTHER RESEARCH METHODS

It borders on historical research, for instance, in the sense that the present case can be understood only in view of its past. It is clearly related to documentary research in that it deals with living individuals in their present social environment. Case studies resemble survey studies in that they are concerned with the present status of phenomena. They differ from survey studies, however, in that the determination

of status is only a secondary aspect in the situation, the more fundamental question is discovering how it got that way.

Case study, as the term is generally used, differ from experimentation in that they display a greater element of subjectivity and institution and, as they are usually conducted that is, in a guidance rather that in a research setting - they are generally oriented towards the solution of a particular problem at the individual level, rather than towards the derivation of generalizations that have scientific validity.

Although case studies constitute the most comprehensive means of studying the whole child, a distinction needs to be made between their guidance and their research functions. Undoubtedly, case studies used for guidance purposes can lead to the derivation of relationships that have a bearing on the research and vice versa. Yet, in the strict sense of the term, research Is' concerned with the derivation of generalizations that apply beyond the individual case, and case studies become research only when they are able to supply such generalizations. Consequently, the case study of Johny, undertaken for the purpose. of helping him to adjust to the school situation, has limited bearing on research.

CASE STUDY VS. STATISTICAL METHODS

In fact, all the methods of scientific research may broadly be classified into two :

(*a*) Statistical Method: These are based on large scale collection of facts. For example, questionnaire, schedule, Interview, observation, etc.

(*b*) Case Study Method: These are based on Intensive study of comparatively fewer cases.

However, both these methods frequently supplement each other since each views a given social situation from different angles and each places a different emphasis on the social factors in the situation. However, in the following way we can compare the two:

Differences Between Case Study and Statistical Method

Case Study	*Statistical Method*
1. It depends upon narrative type description of life situation.	1. It tries to measure (description of situations quantitatively.
2. It takes fewer cases but studies intensively.	2. It believes in interia of large number for valid generalization.
3. Selection of cases is not based on sampling.	3. Here based on sampling.
4. Generalization by common sense and less reliable.	4. Here based on rigid mathematical treatment, and so more reliable.
5. Here greater emphasis upon emotional aspect in order to be applied to social activities of men of groups.	5. It takes an assumption that if large number of cases are taken, the study of even stray aspect of life is possible.

Similarities: Actually, both the methods are similar and interdependent upon each other. For valid generalization case study rests upon statistical techniques, Kmiball Young also says:

"As a matter of fact many of the basic problems of case study method are not unlike those of statistics."

Kimball Young gives the following points of similarity:

1. Case Study Accepts Sampling

The more careful case studies also recognize the problem of sampling, since the aim is to avoid the temptation to generalize from one case.

2. Accepts Central Tendency

In case study references are frequently made to typical cases, which is similar to measure of central tendency or averages.

3. Accepts Variability

Case also try to locate the variations in the reactions and activities of the subject.

4. Also Accept Correlation

The case study data are also compared with other cases to find out the points of similarity and generalizations, thus drawn, are like those of correlation.

It is, thus, quite obvious that fundamentally the two methods are same and interdependent upon each other. Bain has correctly remarked:

"The question today is not case study or quantitative research, it is rather an 'and' relationship."

APPLICATIONS OF CASE STUDY

Case study procedures have been extensively followed in the following fields as law and juvenile delinquency, medicine, psychiatry, psychology, education, counselling and guidance, anthropology, sociology, social work, economics, business administration political science and journalism.

Previously it was limited to only the problems of maladjustment, such as truancy or failure in school a broken or poverty-stricken home or an under privileged or malfunctioning community. But now this approach is also extended to the investigation of normal or bright children, successful institutions and agencies and well organised communities or effectively functioning cultural groups.

The usefulness of the children and case approach may be illustrated by the field of clinical psychology in general and more specifically by counseling psychology and personality study. Clinical psychologists perform a variety of services in many settings dealing with a wide range of human problems. Psychologists first try to achieve understanding based on the hypothesis and techniques of their professional field of knowledge. Then they apply understanding so as to help the people to help themselves with such activities frequently evaluated "diagnosis" and "therapy."

In many instances case study in supplementary to or related to other investigational procedures. The life history of an individual of an institution or of a community resembles historical research in sources and techniques. Case investigation uses many of the data gathering instruments as used in descriptive survey studies. Case investigations of an individual have common interests in growth and development, although ordinarily the direction of movement in case study is backward whereas its genetic research the movement in forward as growth takes place.

EXERCISES

1. Define the term ‘case study’. Indicate the contributions of case study.
2. Enumerate the objectives, phases and types of case study. Illustrate your answer with suitable examples.
3. Indicate the criteria for a good case study. Justify that it is method as well as technique of research.
4. Differentiate between historical and case study. Case study is also casual-comparative study but different from experimental method. Elaborate your answer with examples.
5. What are the various sources of data of case? Enumerate the characteristics of a good case study.
6. Describe the steps employed in conducting a case study. Give rationale for case study.
7. Case study concerns with past (diagnosis), present (prescription or remediation) and future (effect). Elaborate this statement.

Chapter 11

Genetic Method

In twentieth century the increased interest in genetic and developmental psychology is ‘related to the rapid progress of biology. Genetic methods were, in early years, purely biological and were applied to physical and anatomical development. Another factor which prompted genetic approach in psychology and education includes: recognition of the importance of the child as an individual, formulation and development of evolutionary theories, observational and questionnaire studies of the growth of infants and young children, certain psychological moments, and the invention and the use of measuring and recording instruments, especially mental tests, in growth studies.

The basic concept of development fundamentally biological and has been commonly associated with the organization of living structures and life process but in broader terms of word ‘development’ is associated not only with physical changes but also with physical systems, cultures, social institutions, or system of ideas. It is the concept of development, which is applied to behavioural sciences, viz: education, sociology, psychology, anthropology, history, economics, political sciences, etc. The genetic approach could be applied more readily in tracing the developments of the insane, criminal and maladjusted. The techniques of genetic research have to be adopted to the age and nature of the subjects. For example, in studying infants and pre-school children, it may be necessary to use direct measurements and observations and for older children, pencil and paper tests might be used.

MEANING OF GENETIC RESEARCH

Genetic study is ideally long-term investigation of origin direction, trend, rate pattern, limit and decline of growth. Genetic research should identify causes, inter-relationship and patterns of development among such factors as experimental background, including both formal and informal teaching and learning, physiological age, mental age, degree of social maturity or social age, interests, needs, socio-economic status, motivation, attitude, methods of instruction, material of instruction, length and intensity of instruction, learning procedures, modifiability of nature ability, aims and objectives reading ability, habits and procedures . of thinking and in problem solving of the material to be learned.

The relationship between pattern of development for mentality, emotional stability and physical growth is far more significant than separate consideration of data for each phase of growth. This conception is much broader than that of many earlier investigators who considered growth data valuable without practical applications.

PURPOSE OF GENETIC METHOD

The purpose of genetic studies is to discover origin, direction, trends, rate pattern, limit and decline of growth with a more recent interest in cause and interrelationships as factors affecting growth for example the relationships and pattern of development for mentality, emotional stability and physical

growth are more meaningful than separate analysis of each aspect of growth. Adequate interpretation of behaviour includes consideration of children 'of growth rate and optimal development direction indicates whether the child is moving forward, or stationary or regressing rate and indicates whether progress is slow or rapid. It is particularly important in the instruction of gifted children to know whether the level attained represents optimal development in relation to ability.

Investigation of development problem have been extended beyond the classroom, laboratory, nursery, school and child clinic to the church school, home child care agency, camp, playground and discussion group with interest going beyond the earlier physical and anatomical studies to phases of mental, social and personality development. The genetic approach could be applied more readily in tracing the development of the insane criminal and maladjusted, if suitable methods were available for identifying the several types of abnormality or maladjustment an early age as has been done for the gifted, so as to permit a forward movement of observation through the several stages of growth or development the longitudinal approach in most studies of abnormality or maladjustment, it has been necessary to work backward to origin or cause through case or clinical method or the life history since these cases usually reach some critical studies before coming to attention of person equipped with the nature of the case.

TYPES OF GENETIC RESEARCH

There are two types of approaches of solving the problems by genetic method:

1. Cross-sectional Technique, and
2. Longitudinal Technique.

1. Cross-sectional Technique

The Cross-sectional technique requires at least a single measurement for each individual within the particular groups represented as when height is measured for each pupil in the first six grades of a public school system the central tendency for each of the six grades can be calculated and the result represents the 'norms' of growth in height or growth trends from grade to grade or year to year, although these central tendencies are not appropriate 'norms' of growth in height for an individual child.

Advantages

The following are advantages of this technique:

1. The cross-sectional technique has the advantage of gathering the data promptly, as in measuring at one time the height of the children in the first six grades, rather than waiting for the pupils in the first grade to grow in height through a period of six years (a longitudinal technique).
2. It is economical in respect of time because all the samples are available at a time.
3. Relatively large number of subjects are involved in cross-sectional studies, in contrast to much smaller number followed over a period of time in longitudinal studies. If more people have opportunity to be selected as sample.
4. It is economical in respect of energy because all the samples are available at a time.
5. It would be helpful to have norm for such every day activities as dressing habits, ordinary major performance and virtually all practical skills.

Limitations

The following are the limitations of this technique:

1. Cross-sectional approach does not represent the developmental stage of an individual or child.
2. Mostly no prediction can be made.
3. This type of genetic research represents special difficulties in sampling and in statistical procedures.
4. Large and many groups of samples are required.
5. We can not use it for clinical purpose of a particular individual.

2. Longitudinal Technique

The longitudinal approach is considered a sound method than cross-sectional technique. This type of genetic method is used in the repeated observations or measurements of the same child or the same group of children over a period of years. In following the same child, the investigation becomes extended case study. The longitudinal approach to an investigation of the weight of school children is to follow a particular group of people or the same individual year after year through repeated measurements. The resulting series of measurements, therefore, represents growth sequence for the same group of children or same individual.

Advantages

The following are major advantages of this technique:

1. It deals with inter-relation of many variables in growth through the cooperation of socialist in a variety of field.
2. It represents the cross-sectional of development stages of an individual child.
3. Prediction can be made for a subject.
4. Real development may be studied by this method.
5. This method is less difficult in sampling and statistical technique in comparison to cross-sectional method.
6. Small sample is selected.
7. It can be used for the clinical purpose for a particular pupil.

Disadvantages

This technique suffers from the following limitations:

1. It is not helpful in providing the norms for every day activities.
2. Uniform sampling criteria, as employed in cross-sectional studies, cannot be set up and applied for longitudinal data, since unpredictable and uncontrollable selective elimination almost inevitably occurs because of the causalities of death, illness, moving of families and changes in the co-operation of parents with the investigator.
3. It is time consuming.

Although wider use of the longitudinal method has been recommended, rather specific precautions are necessary in dealing with certain difficulties some of which are common to cross-sectional studies.

1. Difficulties in population sampling, such as the selective elimination of many of the original subjects during the course of a long term investigation.

2. Maintenance of satisfactory working relationships among subjects, parents, schools and investigators particularly as personnel changes takes place with the passing of time.
3. Motivation of children to demonstrate full rather than perfunctory performance. A real challenge in the case of repeated testing over a period of month of years.
4. Systematic errors of measurement in the administration or scoring of tests mental or physical.
5. Non-comparability or uncertainty of uncertain psychological equivalence of test used at different age level, especially when the time span is from early childhood to adolescence.
6. Unequal experience of groups in terms of factors affecting the results of the measurement used, but not affecting the trait itself: for example, variation in previous experiences with standardized tests.
7. Recording and collection of data for example work of graduate students probably not as accurate and efficient as a highly trained permanent staff or skilled punch 'operators and statistical clerks.
8. Mistakes or interpretation resulting from failure to take into account the principle of regression, particularly in its effects of measurement of gain or loss.

PROBLEM OF GENETIC RESEARCH

The research of genetic problem is not limit to classroom, laboratory nursery school and child clinic, but may be carried forward in the church school, home child care agency, playground and discussion group. As the scope of problems to the earlier in physical and anatomical growth is newly added phases of mental, social and personality development as profitable areas for research. The breadth of the field is indicated by the content of treatise and we trace the development of psychological processes in animal ranging from unicellular organism to man. As further evidence of the breadth of genetic approach, investigation of mental and physical growth has enough answers to the following problems:

1. Individual, age, maturity, sex and ethnic differences in growth.
2. The general nature of growth curves their inception, shape and point of cessation.
3. The nature cause and results of abnormal growth.
4. The nature of growth curves of various structures.
5. Relationship between mental and physical growth.
6. The relationship of physical growth to abnormalities of behaviour.
7. The relation of growth to environmental changes.
8. The study of effectiveness of methods and techniques for obtaining the above information.

There are certain fields to which the genetic method could be applied more rapidly to the gifted, criminal and maladjusted in general as to secure a faithful record of past biological events in the developmental history of individual or group to discover cause and effects relationship, principle of development, common likeness and differences in the development history of individual or groups of persons to determine change in interest, capabilities and abilities from the one age level to another for either individuals or groups of persons to secure age grade norms of development for group of children.

SOURCES OF GENETIC DATA

Among the sources for study of child development are the following:

1. The present behaviour of the child, including verbal output, as based on observations, measurement and records or experimental situations, or on direct observation of behaviour in play and social settings.
2. Products of the child in the form of permanent records including drawings, letters, and compositions.
3. Records on file at home, school and in a variety of agencies covering school achievement, birth certificates and health records.
4. Introspections of the child.
5. Memories of the child, or the adult of his own earlier life, as based on the recording of conscious memories or of getting at more deeply buried memories by a free association process or projective methods.
6. Memories of the child's life as retained by those who have been associated with him.
7. Measures of the parents, siblings, and other relatives of child or of the environment, culture or background in which he develops-a source that actually does not provide direct information concerning with the child.
8. Historical and biographical materials-both genetic and historical studies deal with the sequence and unfolding events, but genetic approach centres attention on events relating to individual growth or past roots. The historical approach employs the entire range of human events.
9. Survey instruments: Genetic research makes extensive use of the varied data-collecting and recording tools of normative- survey methods (testing, questionnaire, scales, interview and records).
10. Experimental technique; Genetic approach is frequently used in combination with experimental inquiry, as when employing parallel groups to study the effect on growth of variation in a nutritional factors.

DESIGN FOR GENETIC RESEARCH

The genetic method includes at least three possibilities of designs:

1. Experimentation through the technique of the control group and co-twins control.
2. The behaviour survey.
3. The Individual case study: Studies of different phases of growth: intellectual, emotional and physical. Projective techniques are used for emotional has emphasized longitudinal studies of the same children over a period of time.

(*a*) Developmental Evaluation

1. **Developmental Examination:** Naturalistic observations, organisation and consistency of performance of simple tools, standardized psychometric tests, subjective techniques.
2. **Visual Examination:** Case history, visual analysis, visual skill.
3. **Physical Growth Evaluation:** Observations of sequence to situation, standard physical growth measures standardicated physique photographs.

(*b*) Subject Interview

Topic covering emotion sense of self, inter-personal relationship activities and interest self-care and routine, action system, school ethical sense philosophical outlook.

(*c*) Teacher Interview

Survey Instruments

Genetic investigation makes extensive use of the varied data collecting and recording tools or normative survey method including developmental examinations, growth schedules, behaviour records tests, anecdotal journals, anthropometric measuring instruments standard, rating scales, checklist, questionnaire interviews and direct observation. The types of sociological, psychological, educational, economic and medical phases of growth.

ANALYSIS AND INTERPRETATION OF GENETIC DATA

There are certain principles for analysis and interpretation of genetic data. These are as follows:

(*a*) Principles of Child Development

Certain principles of child development which many be classified under the following abbreviated headings are helpful as background for discussion of the several aspects of human growth and development.

1. Developmental objectives.
2. Levels of maturity.
3. Differential rates of maturing.
4. Variability in rate of maturing.
5. Differential developmental pre-eminence at various stages of growth.
6. Whole heartedness and gradation in emotional development.
7. Variabilities in differential rate of maturing.
8. Indigenous motivation or spontaneous use as a feature of growing ability.
9. The principle of anticipation.
10. "Laying By" or sheding as a feature of developing. Developmental revision of habits.
11. Differentiation and integration.
    (*a*) Individualization.
    (*b*) Progression from generalised to more localized response.
    (*c*) In corporation of separately practised operation into the larger activity system.
13. Priority of "larger" over "small" nuclear activities in certain sections of the body.
14. Interaction between various aspects of growth.
15. Various extensions of experience.
16. Early establishment of some of the basic features of personality structure.
17. The play of complementary and potentially conflicting force.
    (*a*) Dependence or independence
    (*b*) Self-centered and out-going tendencies.

(*b*) Initial Stage

Interpreting growth and development, certain stages and processes are significant, as reported in the classic studies of genetic and the beginning of development is important in genetic research. The initial stages of certain types of behaviour in infancy are commonly as follows:

1. In the first quarter or the 1st year he gains control of the muscles that moves his legs.

2. The second quarter reach out for thing.
3. Third quarter, sits.
4. Fourth quarter stands upright.

Second year walks and runs, and articulate words and phrases and in the third year, speaks in sentences, using words as tools of thought.

(*c*) Qualitative and Quantitative Changes

Growth or development is both quantitative and qualitative. Growth In vocabulary involves both the total number of words used for qualitative changes and the effectiveness of usage in speaking or writing a relatively qualitative phase of development. Qualitative changes in growth commonly are expressed descriptive terms for example of different stages of development in infant commonly responds to the minor situation as follows as 40 weeks smiles at his mirror image; at 52 weeks, approaches his mirror image socially and even vocalizes; and at 56 weeks, brings his face close to his image, sometimes kissing it.

(*d*) Rate of Growth in Terms of Trends and Patterns

A basic continuity characterize human psychological development in the sense that pattern of personality and adjustment once established tend to persist over long periods of time, although environmental or constitutional factors or circumstances, under certain conditions might alter the growth trend of particular individual. The interrelation of development trends is noted in the positive correlation of desirable traits and in a certain unity of growth. Although in physical and social interaction and possibly in intelligence, some alteration in direction or rate of growth is associated with presence, anything approaching recognization of personality has not been demonstrated. The characteristics of any age group such as adolescents must be evaluated in the perspective of what has gone before and what follows:

(*e*) Stages of Growth and Integration

Reasonable unity or integration development prevails at a particular stage of growth although there are many exceptions. The normal boys reach similar stages of development intellectually, educationally, socially and physically. On the other hand an exceptional boy may be small in physical size but will answer questions in a quiz-show at the college level in science and mathematics. Another exception to the concept of integrated growth at a particular stage is the adolescent boy who may be 6 feet in height but quite immature socially and emotionally. The vestibules of the ear is of adult size at birth but the heart has not fully completed it's growth. At the age of 20, as a general rule the several aspects of development lend to cluster around a centre of gravity of growth for the individual.

(*f*) Individuality of Growth

Although there are stages of maturation and behaviour that reveal basic or common trends in development, not even identical twins grow up in exactly the same way individuality of behaviour in motor activity relates to such item as output of energy, bodily activity and fatigue ability and postural demeanour with the latter noted to determine whether it is relaxed, poised, steady or variable, adaptive behaviour varies in terms of insight inquisitiveness originality, decisiveness and initiative language is characterized by individual differences in articulation flow of speech inflections, inhibitions, conversational support and expressiveness. Personal social behaviour reflects variations in emotional vitality motivation reaction to success failure and fatigue reaction to novelty and surprise and sense of humour.

(g) Limit of Growth and Old Age

The upper limit of physical growth or performance can be determined with considerable precision as in height or speed of running but little is known concerning maximum mental development or performance. It may be that quantitative growth of intelligence continues until 10 or 19 years or even later although qualitative and functional development of intelligence in terms vocabulary, information and insight or power in contrast to speed of reaction probably continues well beyond the age of 20. In term of physical and psychological development adulthood is reached soon after the age of 20 followed by a few years at the peaks of physical efficiency and then some physical deterioration actually beginning as early as the late 20's as is well known in the atheletic sports of physical maturity and physiological equilibrium are lost in part only a few years after attainment. Fortunately the relatively early deterioration of the anatomical and physiological functions may be offset by creative imagination, enriched experience and good judgement thus permitting the intellect to operate In a socially effective manner changes in test performance of a quantitative sort during maturity and old age may be offset by qualitative aspects of intellectual performance. It is well known that disease may produce marked changes in behaviour and even disintegration of personality.

DIAGNOSIS AND PROGNOSIS

Interest in the development diagnosis and causation come later than the investigations limited to determination the growth of norms or sequences. A common error in identifying causation in failure or to recognize the combined effects of two or more casual factors that are interrelated functionally as illustrated by the differently or separating the influence of nature from nature on achievement as casual factor that effects growth, and development includes race, age, sex, heredity parental conditions of birth, order, maternal age at pregnancy; nutritional factors, health factors disease and infections, seasonal conditional atmosphere conditions temperature humidity and pressure national, racial culture socio-economic status, educational agencies, social pressure, family and neighbourhood acquaintances and friends intelligence, knowledge, experience, exercise and training, interest and motivation and emotional adjustments.

The factor which affecting physical and mental growth suggest the difficulties of developmental progresses and prediction. Prediction in such area as constancy of I.Q., height, time of maturity and age at which growth will cease is possible. Only to the extent that valid technique and instrument of measurement are available, that early development provides a stable base from which subsequent proceeds, and that later development is affected by the same casual factors as operated in the earlier stages of growth. It is much simpler to predict in the area of physical growth and performance than in the field of mentally and personality development.

NEEDED RESEARCH

While available sources have enumerated detailed series of problems in child development that touch the interests of education, psychology and sociology, only a selected list of major problems for genetic investigation can be presented.

1. Increased observation of development and behaviour changes in relation to classroom activities, nursery school, play ground, camp and even adult behaviour.

2. In addition to growth investigation of individual and of relatively broad sample, study of developmental aspects of homogeneous groups and even adult behaviour.
3. Developmental study of experimental modification or alteration of behaviour.
4. Invention of improved instruments suitable for measuring mental development in the late teens and early twenties.
5. Further emphasis on developmental studies that seek to secure a reasonable picture of the "total child" for example to identify interrelationship between mental, physical and social emotional factors.
6. A complete description of how individual children acquire certain social attitude, ideals, interests and modes of behaviour.
7. Comparative sociological studies of children growing up under clearly defined social levels and backgrounds of different types.
8. Evaluation of the effectiveness of social and institutional programmes for child welfare in terms of wholesome development of children.
9. Appraisal of the effects of periods of depression and war on the development of children.

CONCLUDING STATEMENT

The interest of genetic research has now extended for beyond the early emphasis on physical and anatomical growth to mental, social and personality development and also includes study of casual factors as well as growth norms and developmental sequence. The scope of generic research for human individuals includes growth and developmental processes from conception to senescence.

EXERCISES

1. What do you mean by Genetic Research? Enumerate the purpose and importance of Genetic Research in Education.
2. Distinguish among Historical, Case study and Genetic method of research though all these methods are based on time sense approach.
3. "Genetic Researches employ both the research approaches: longitudinal and cross-sectional". Comment on this statement.
4. Enumerate the steps of Genetic method, which are used for conducting such study.
5. Describe the design of Genetic method and illustrate your answer with examples.
6. "Genetic researches concern with growth and development, therefore it requires both quantitative and qualitative analysis and interpretation." Elaborate this statement.
7. "Genetic research employs diagnostic and prognostic functions". Indicate the limitations of Genetic method research in the field of Education and enumerate some problems of Genetic research in Education.

Chapter 12

Design of Experiments

Experimental method is the most sophisticated way of research, particularly in sciences. In this way we study some variables by controlling some variables affecting the previous one. When certain variables can be controlled or manipulated directly in research problem by the investigator, the research procedure is often described as an experiment.

Thus, in an experiment we observe and measure the effect of treatment given to few variables by controlling other variables affecting our observations. The term "treatment" refers to a particular experimental condition. The material to which the treatment is applied and on which the variable under study is measured, is known as experimental unit. Since all variables cannot be controlled, it may cause the error in our observations. It is the experimental error. The whole experiment is conducted according to some plan which is called the design of experiment or experimental design.

Thus, an experimental design is a plan or strategy of investigation conceived so as to solve the research problem.

NEEDS AND PURPOSE OF EXPERIMENTAL DESIGN

Generally in an experiment we take observation and infer that the hypothesized relation exists on the basis of the observation taken, but it is obvious that we can not rely on this inference. It is due to the numerous variables which are affecting our experiment and which we have not controlled. Thus in the inference drawn by observation, the influences of these uncontrolled variables will also be included and we firmly can't say that the inference is due to 'treatment given', i.e. 'hypothesis made' or by some another factor. So, experimental design is the need for precision of our experiment. Precision means the degree to which extent we can rely on our observations and inferences due to treatment given. This precision depends upon the success with which the affecting variables have been controlled. The absolute precision, of course, is not possible.

Moreover, we want our inferences as valid, objective, accurate and economically as possible.

For all these causes an adequately planned and executed design help greatly in permitting us to rely on and to obtain both our observations and inferences. Mainly an experimental design serves two purposes (*i*) to provide answers to research questions and (*ii*) to control the variance due to various factors.

IMPORTANCE OF EXPERIMENTAL DESIGNS

Without a design, research study is just like the building construction without any plan or map. The design enables us to answer research questions as validly, objectively, precisely and economically as possible.

An experimental design sets up a framework for adequate tests of the relations among variables. Design tells us in a sense "what observations to make", "how to make them", and how to analyze the quantitative representations of the observations. Strictly speaking, design does not tell us precisely what to do, but rather "suggests" the directions of observations making and analysis. A design suggests which variables are active and which are assigned. We can then act to manipulate the active variables and to control the assigned variables.

A design also suggests, what type of statistical analysis to use and what may be the inferences by a particular technique applied.

The results obtained in a study dealing with human behaviour can never be considered absolutely accurate due to numerous variables. A design tells us "how far we have been able to control the experimental errors". Most technical function of an experimental design is to control the error variances.

THE NEED FOR PRECISION

The precision of any experiment may be defined as the degree to which the observed differences in results, from group to group are due to the only differences which have been deliberately introduced into 'treatments the precision of the experiment" will then depend upon the success with which all factors which might otherwise affect the result other than the deliberate variations in "treatment" have been controlled or equalized from group to group and upon the extent to which the criterion measures really measure the things which they are interested to measure.

Absolute precision is, of course, impossible, in other words it is always possible that any observed difference in results is due not to the treatment differences but to uncontrolled and unmeasured variations in factors extraneous to the purpose of the experiment. It is impossible to determine the magnitude and direction of these errors, we only can calculate or determine the possibility that the errors arising from certain sources will exceed a given magnitude and estimate the maximum error that it is reasonable to suppose might arise from these sources.

THE ESSENTIAL CHARACTERISTICS OF A GOOD EXPERIMENTAL DESIGN

The essential characteristics of a good experimental design may be summarized as follows:

1. It will ensure that the observed treatment effects are unbiased estimates of the true effects.
2. It will permit a quantitative description of the observed treatment effects regarded as estimates of the "true" effects. It will ensure that the observed treatment effects will have whatever degree of precision is required by the broader purpose of the experiment.
3. It will make possible an objective test of a specified hypothesis concerning the true effects, that is, it will permit the computation of the relative frequency with which the observed discrepancy between observation and hypothesis would be exceeded if the hypotheses were true.
4. It will be efficient, that is, it will satisfy these requirements at the minimum "cost" broadly conceived.

These are not only essential characteristics of a good experiment. The usefulness or worthwhileness of an experimental is primarily depend upon many other factors.

The important decisions to be made in planning the experiment are considered with:

1. The definition of the "treatments."

2. The selection or exact definition of the population to be investigated.
3. The selection of a criterion.
4. The identification of the factors to be controlled and the level or levels at which each is to be controlled.
5. The final restatement of the problem, and
6. The selection of a specific experimental design.

These decisions are independent. A decision made a particular stage in the planning may require modifications in previous tentative decisions, which may in turn affect other previous decisions etc. The selection of the experimental design is usually the last step taken, but as already noted, even it may suggest desirable modifications in other decisions previously made.

VARIOUS TYPES OF ERRORS

Generally in an experimental study errors may be of two kinds: (1) Chance error and (2) Systematic error.

1. Chance Error: This error is due to the individual differences, e.g., if we are studying the superiority of programmed method over traditional method, then the differences in intelligence, learning ability, socio-economic status, established habit of study, etc. may affect our study.

In chance error two categories may be according to the sources of errors.

(*a*) Sampling Error: The error is due to the differences within the sample chosen for study is known as sampling error, e.g., in the above study habit of study, intelligence etc.

(*b*) Measurement Error: It is due to inability of measuring instruments to produce accurate results.

2. Systematic Error: Inspite of precautions taken, other factors than those involved in study, may affect our experiment during study. It causes results to vary in a particular direction. Systematic error causes bias in study and it is far more likely to catch the researcher by surprise than does chance error, e.g., in the above study the differences in circumstances attending the administration of methods, poor or well ventilation of classroom, teacher's performance etc. A rather famous source of systematic error in research studies is the "Hawthorne effect". Whenever a new method or treatment is studied the persons, using it, try to prove it better, no matter which is actually superior. Generally the researcher wants to prove his hypothesis this way or that way. This kind of effect cannot be controlled completely.

Every researcher tries to control these errors through experimental designs. Kerlinger has pointed out that a researcher attempts in three ways for error variance control.

1. Maximizing the Variance of Desired Variables

The experimenter's most obvious concern is to maximize the experimental variance. It simply refers to the variance presumably introduced into dependent variable by the independent variables being manipulated or controlled. It is variance of the independent variables of the substantive hypothesis. If the independent variable does not vary substantially, there is little chance of separating its effect from the total variance of the dependent variable, so much of which is often due to chance. It is necessary to give the independent variables a chance to show their variances, to separate themselves from total variance which is a composite of variances due to various variables. Remembering this Maximincon Principle we can write a research percept as – design, plan and conduct research so that the experimental conditions are as different as possible.

2. Controlling the Variance of Extraneous Variables

It means that the influences of independent variables extraneous to the purposes of study are minimized, or isolated. In other words the variance of such undesired variables is in effect reduced to zero or near zero. It is done in the following ways:

(*a*) To eliminate the variance as variable e.g. if we are studying achievement and racial membership is a possible contributing factor to the variance of achievement, it can be eliminated by using only members of one race.

(*b*) Second way is through randomization. If we do randomization then the experimental groups can be considered statistically equal in all possible ways. Group can be unequal by chance, but the probability of their being equal is much greater, with proper randomization, than the probability of their not being equal.

(*c*) Third way is to build it right into the design as an independent variable, e.g., sex was to be controlled in any experiment and it was not possible to assign subjects to groups at random. One could add another independent variable sex, to the design.

(*d*) Fourth is to match the subjects. The basic principle behind it is to split a variable into two or more parts and randomize within each level.

3. Minimizing the Error or Random Variance

Error variance is the variability of measures generated by random fluctuations whose basic characteristics is that they are selfcompensating varying this way or that way. Random errors tend to balance each other but the error variance is unpredictable, which is due to the factors associated with individual differences, variation of responses from trial to trial. So we try to reduce the errors of measurement through controlled conditions and by increasing reliability of measures. Reason to reduce error variance is to give systematic variances a chance to show their significance if they are significant.

The sampling error is reduced by controlling extraneous variables and applying the Maximinicon Principle.

The error of measurement controlled by minimizing the error variances and using reliable instruments.

The systematic error may be reduced with proper care by investigator to some extent.

The degree of error to which we were able to eliminate or control depend upon the experimental design used. These experimental designs are based on some principles.

Each design has its own assumptions, lay-out and technique of analysis.

BASIC PRINCIPLES OF EXPERIMENTAL DESIGN

The three principles of experimental design namely the indispensability of replication and randomisation, and the desirability of local control are developed by R.A. Fisher. From these the modern experimental designs have been evolved.

1. Randomization

The principle of randomization, as advocated by Fisher, is essential for a valid estimate of the experimental error and also to minimise bias in results. Cochran and Cox stated:

"Randomization is analogous to insurance in that it is a precaution against disturbances that may or may not occur, and that may or may not be serious if they do occur."

Also, designs we frequently use analysis of variance which holds the assumption of independence of variances, randomisation is a device to achieve this independence of variances, randomisation is a device to achieve this independence of errors. Randomisation by itself is not sufficient for the validity of the experiment. It only forms the basis for validity.

Randomization may be done by any technique by lottery or Fisher bowl technique or random number tables.

2. Replication

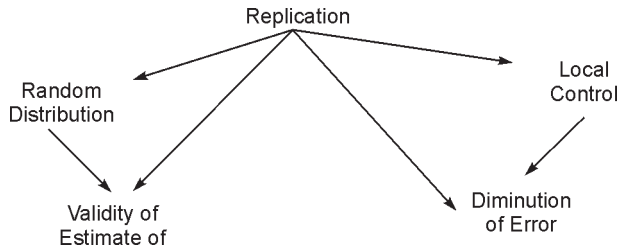
A treatment is repeated a number of times in order to obtain a more reliable estimate than is possible from a single observation. It is apparent from Fisher's diagram that the function of replication is two-fold: (1) along with randomisatin, it provides an estimate of the error to which comparisons are subjected, and (2) alongwith local control it reduces the experimental error. The most effective way to increase the precision of an experiment is to repeat the experiment.

Since $S.E_M = \sigma / \sqrt{n}$ or Standard Error of Mean

Standard error ($S.E_M$) decreases when N, the size of sample increases. But replication beyond the limit may be impractical because it also depends on experimental unit, time, cost, experimenter's ability, etc. Replication broadens the scope of experiment.

3. Local Control

The third principle is called local or error control. As already mentioned replication with local control reduces the experimental error. In simplest case, experimental units are divided into homogenous groups. The variation among these groups is eliminated from the error and thereby efficiency is increased. The choice of size and shape of experimental units, environmental conditions etc. have also some effect on experiment, causing errors. It may be controlled by using analysis of co-variance also.



Fisher Diagram

Local control helps in controlling the systematic error or general factors or say "*G*" error, Randomization controls the sampling error or "*S*" error and also a little "*G*" error replication, mainly controls the variations in treatment effects from replication to replication due neither to "*S*" nor "*G*" type of errors. Let us call it "*R*" error. Measurement error is controlled by replication. Replication with randomisation would be able to control all the three errors and with local control, the "*G*" error and measurement error. So replication is a very important principle.

TYPES OF BASIC EXPERIMENTAL DESIGNS

These basic principles are applied to all experimental designs, therefore, these designs are also known as Basic Experimental Designs. Now let us discuss various experimental designs which are being summarized by E.F. Lindquist as follows:

1. Simple Random Design,
2. Treatment X Level Design,
3. Subject X Treatment Design,
4. Random Replication Design,
5. Group Within Treatment Design, and
6. Factorial Design.

E.F. Lindquist (1956) has given these six basic experimental designs. These are known as basic designs because, their focus is to eliminate three basic types of errors: Type '*S*' erros, Type '*R*' errors and Type '*G*' errors.

Type '*S*' Errors: That part of an observed treatment effect which is due solely to the assignment of subjects to treatment groups is called as a Type '*S*' errors.

Type '*R*' Errors: Variations in treatment effects from replication to replication, due neither to Type '*S*' nor Type '*G*' errors, but genuinely characteristics of the individual replications or sub-populations are referred to as Type '*R*' errors.

Type '*G*' Errors: Are those due to the operation of extraneous factors which tend to have the same effect on all members of any given treatment groups, but different effects on different treatment groups in any simple replication.

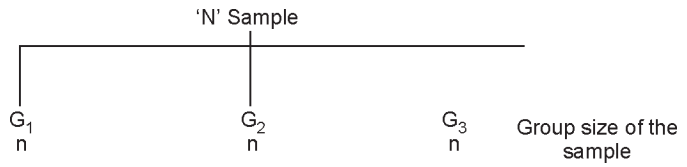
Lindquist has developed these six models of basic experimental designs which are oriented to control the effect of these three basic types of errors. The first three models of basic designs concentrate on type '*S*' error only and do not consider the effect of remaining two types of errors. The third design attempt to eliminate the influence of Type '*S*' and '*R*' errors. The fourth design tries to eliminate the confounding or contamination effect. The last design attempts to control the effect of all three basic types of errors. The description and model of these designs have been given in the following paras:

1. Simple Random Design

Simple randomized designs are those in which each treatment is independently administered to different sample of subjects all samples are independently drawn at random from the same parent population. These selected subjects are divided randomly into desired number of treatments and these groups were assigned to the treatments randomly so the randomization is done at every stage of experimentation. This randomization is done because the main focus of this design to eliminate *S*-error. This design is based on simple random sampling technique.

Layout of Design

Subjects are drawn randomly from population. These are divided into three groups randomly and assigned to three treatments randomly.



The three groups are assigned randomly to the treatments.

Treatments

A_1	A_2	A_3
X_1	Y_1	Z_1
X_2	Y_2	Z_2 Scores on criterion test
X_3	Y_3	Z_3
–	–	–
–	–	–
–	–	–
X_n	Y_n	Z_n

A random sample is selected from the population. The sample N is divided into 3 groups randomly and each group is assigned to these different methods randomly. After this experiment criterion test is administered to all in the groups and then we get three sets scores.

Treatment or Analysis of Data: Analysis of variance technique is used for calculating *SSt i SSb*, and SSw and we prepare analysis table.

Analysis Variance Table

Source	*df.*	*SS*	*MS*	*F*
Between	*K*–1	*SSb*	$MSb = \frac{SSb}{K-1}$	$F = \frac{MSb}{MSw}$
Within	*N*–*K*	*SSw*	$MSw = \frac{SSw}{N-K}$	df. (*K*–1), (*N*–*K*)
Total	*N*–1	*SST*		

One way analysis of variance technique can be used to obtain the '*F*' value. If *F* is significant '*t*' test is followed to locate difference among the methods available, if the same criterion test would be administered before the treatment. The more precise result may be obtained with the help of pretest. It eliminates the following errors too:

1. It will give the initial learning of the group.
2. By this we can eliminate '*S* error too.

Advantages

The following are the main advantages of this design:.

1. It allows to study the treatment effects of the experimental variable.
2. It attempts to eliminate the '*S*' error through randomization.
3. Simple one way analysis of variance is applied for studying the main effect of treatments.
4. Effect of more than two treatments can be studied simultaneously.
5. It is very simple and easy experimental design.

Disadvantage

The following are the limitations of this design:

1. Though it attempts to eliminate '*S*' error, but we can not ensure that *S*-error is completely minimized.
2. Only the main effect of one variable can be studied.
3. It concentrates only to *S* error: other basic type of errors Le., '*G*'error and '*R*'errors are not considered.
4. This design is not applicable in educational research, because no principal or parent or teacher will allow to select subjects randomly and to keep in experimental and controlled situations, and
5. Neither the subjects will cooperate.

Suggestions

The following precautions, may be taken in using this design:

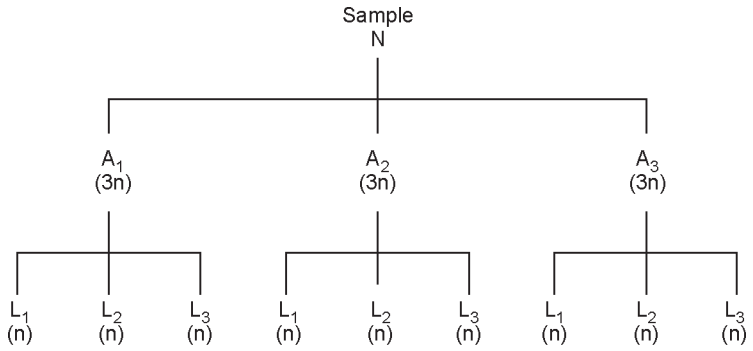
1. Randomization should be done rigorously at every step.
2. Pre-test and post-test should be administered for analysing the effect of treatment and analysis of covariance technique should be employed for analysing the data, so that net gain may be tested and more precise results may be obtained.

2. Levels X Treatments Design

This design is a direct improvement over simple random design in the sense that in this design '*S*'error is minimized and we guarantee that sampling error has been controlled. It provides a direct control for intra subjects variations. The main focus of design is to control '*S*' error. It does not consider '*G*' and '*R*' errors. In this design stratified sampling technique is used. It means the population is classified on the basis of some relevant criterion. Thus, the strata are formed on the basis of criterion subjects from each stratum is assigned to each treatment and each treatment is assigned to every level of subject; these treatments should be assigned independently. The purpose of assigning treatment to each level of subjects is to eliminate the '*S*'error.

Layout of the Design

In this design levels are introduced only to equate the groups for studying in main effects. The 'N' size of sample is selected from the population. It is stratified into three levels. An equal number of subjects are taken from each level. The subjects of each level are assigned to each treatment as shown below:



Treatments

Levels	A_1	A_2	A_3
L_1 Criterion	n	n	n
L_2 Intelligence	n	n	n
L_3	n	n	n
Experimental Variables is administered.			
Criterion Test Scores	X_1	Y_1	Z_1
	X_2	Y_2	Z_2
	X_3	Y_3	Z_3
	–	–	–
	–	–	–
	X_n	Yn	Z_n
Total	$\sum x$	$\sum y$	$\sum z = \sum i$

Analysis of Data

Simple one way analysis of variance technique may be used for analysis. The main effect of treatment is analyzed as follows:

Analysis Variance Table

Source	*df.*	*SS*	*MS*	*F*
Between	(K–1)	*SSb*	*MSb*	$F = \frac{MSb}{MSw}$
Within	N–K	*SSw*	*MSw*	$df \rightarrow (K–1), (N–K)$
Total	N–1	*SSt*		

The significance of F value with (K–1), (N–K) degrees of freedom is ascertained with the help of Table and interpretation of the result is done. The conclusions are drawn about effectiveness of treatments. There are three treatments, which therefore, '*t*', must be followed if '*F*' is significant.

Advantages

The following are the advantages of this design:

1. It is the direct improvement over simple randomised design.
2. It eliminates '*S*' error by selecting subjects from each level.
3. This design yields relatively more dependable and accurate results than earlier one.

Disadvantages

The following are the limitations of this design:

1. This design has less difference than the simple randomized design because type '*G*' and '*R*' errors are not considered in this design.
2. The levels are formed only on the basis of one criterion. Thus, the groups are equated quantitatively but not qualitatively. So the intra subjects variation is not controlled.
3. It is a difficult job to consider the criterion for stratifying the sample. In an investigation a number of criterion seem to be equally relevant in that situation, it is difficult for investigator to choose the most relevant criterion for stratification.
4. This design generally confused with the factorial design.
5. The design is not practicable in teaching-learning situation.

Suggestions

The following precautions should be taken in using the design:

1. Other improved designs may be used.
2. Pre-test and post -test should be administered and we should prefer analysis of covariance technique.
3. The levels and treatments effect may be considered for obtaining accurate results

3. Treatments X Subjects Design

Treatment X Subjects designs are those in which all treatments are successively given to the same subjects. The choice of this design is conditioned by the fact that treatments are such that all can be administered in a sequence to the same subjects and the effects of each treatment are influenced by the fact that other treatments have previously been administered to the same subjects. Thus, it is possible to eliminate entirely the influence of inter-subjects differences upon the treatments effect. Since exactly the same subjects are assigned in all the treatments, no part of the difference in the treatment means can be attributed to differences among subjects. This design eliminates entirely the 'S'error. Although the chance error of measurement might still favour one treatment or the other inter subjects differences are usually a major source of error in educational and psychological experiments. This design is more precise then simple randomized design and treatments X Levels design.

Model or Layout of Design

The same subjects are assigned to each treatment successively as shown below:

Treatments

	T_1	T_2	T_3
Subjects	*A*	*B*	*C*
	C	*A*	*B*
	B	*C*	*A*
	–	–	–
Treatment	M_1	M_2	M_3 Main effects

Analysis of Data

The analysis of variance technique is used to analyze the main effects of treatment.

Analysis Variance Table

Source	*df.*	*S S*	*MS*	*F*
Treatment	a–1	SS_A	MS_A	$F = \frac{MS_A}{MS_{AS}}$
Subjects S	s–a	SS_S	*MSA*	
Treatment & Subject As	(a–1)(s–1)	SS_{AS}	MS_{AS}	$df(a–1), (S–1)$
Total	N–1	*SSr*		

The significance of F is examined for the result.

Advantages

The following are the main advantages of this design:

1. The treatments *X* Subjects design is usually for more precise than the simple randomized or treatments *X* levels design, granting that a fairly reliable criterion measure is employed.
2. This design is a useful design so far concerned with the sampling error. It eliminates entirely the '*S*' error.

Disadvantages

The following are the limitations of this design:

1. The effect of given treatment is usually not independent or unaffected by the previous administration of another treatment to the same subjects.
2. The use of this design usually requires that equivalent forms of a criterion test be available, so as to eliminate or render negligible the practice effect of taking the same test more than once.
3. The design does not take into consideration type '*G*' and type '*R*' errors.
4. The same subjects are assigned to the same treatments, it causes, '*R*' errors because the subjects are the replicates. It means that intervening variables may influence the treatment effect.

4. Random Replication Design

Random replication designs are those in which the same basic experiment (or simple-randomized type) is "replicated" (repeated) with independent samples of subjects. The purpose of random replication design is to control type *S* error and type *R* error. The experiment is designed in different types of institutions by using simple random design. The subjects for the various "replication" may be drawn from the same population or the experiment as a whole may be concerned with a population or the experiment of a large number of sub-population and the subjects for each replication may be drawn at random from a different and randomly selected sub-population.

Random replication design in general differs from simple random design. The experiment is repeated by selecting random sample from different types of institutions. It means the simple random replication design is the repetition of the experiment on sub- population. Each replication is performed for a different subpopulation selected at random from the total population.

The only errors which are not taken into consideration in test of significance employ for the design are those which have not been randomized independently in each replication or which are constant for all replication.

Layout of Design

The following is the layout of the replication design for two treatments.

	A_1	A_2	*Difference*
Replication 1	MA_1R_1	MA_2R_1	$D_1 = MA_1R_1 - MA_2R_1$
Replication 2	MA_1R_2	MA_2R_2	D_2
Replication 3	MA_1R_3	MA_2R_3	D_3
Replication 4	MA_1R_4	MA_2R_4	D_4
Replication 5	MA_1R_5	MA_2R_5	D_5
Mean	MA_1	MA_2	$D = MA_1 - MA_2$

$$t = \frac{MA_1 - MA_{A2}}{es'd\sigma D}$$

Layout

The following is the layout of replication design for three treatments. Three schools are replication.

Treatments

		T_1	T_2	T_3
Institutions	S_1	n	n	n
	S_2	n	n	n
	S_3	n	n	n
		–	–	–
		M_1	M_2	M_3

The two way analysis of variance technique is used to analyse the data. The following is the statistical model.

Treatments

Source	*df.*	*SS*	*MS*	*F*
Treatment A	a–1	SS_A	MS_A	For treatment effect
Schools	$i = k$	SS_i	MS_i	$F_A = \frac{MS_a}{MSai}$
Replication				For school effect
X School	(i–k) (a–1)	SS_{ai}	MS_{ai}	$F_i = \frac{MS_i}{MSai}$
				df (i–1), (a–1) (i–K)
Total	N–1	SSr		

The main effect of treatment is tested through F_A value.

It also studies the effect of institutions and then this design becomes factorial design. The significance of values F is ascertained for interpreting the results.

Advantages

The following are the advantages of the design:

1. It takes into consideration all the three type G, type S and type R errors.
2. Since type S and type R errors may be relatively very important in many educational and psychology experiment, it is apparent that the random replication design represents a very marked improvement over the earlier designs.
3. Effect of institutions may also be studied simultaneously.
4. It is most frequently used in educational studies.

Limitations

The following are the limitations of this design:

The only G-errors which are not taken into consideration in this test are those which have not been randomized independently in each replication or 'G' are constant for all replications.

Types of Effects in Factorial Design

The difference between Treatments X levels design and factorial design is that the interest conceivable might be greater in the interaction effect that in the main effect of the treatments, and two or more experimental variables may be studied in a single experiment.

The Treatment X levels design has the focus to study the main effect of treatments whereas factorial design attempts to study the interaction effect of two or more experimental variables. These effects have been illustrated here:

Treatments A

Levels B	B_1	M_{11}	M_{12}	MB_1
	B_2	M_{21}	M_{22}	MB_2
		MA_1	MA_2	

This example has two main effects, two simple effects and two interaction.

Main Effect of Treatment $A = (MA_1 - MA_2) = D_1$

Main Effect of levels $B = (MB_1 - MB_2) = D_2$

Simple Effect of Treatment at B_1 level = $(M_{12} - M_{12}) = d_1$

Simple Effect of Treatment at B_2 level = $(M_{21} - M_{22}) = d_2$

Interaction Effect = $(d_1 - d_2)$

Simple Effect of level at A_1 Treatment = $(M_{11} - M_{21}) = d_3$

Simple Effect of level at A_2 Treatment = $(M_{12} - M_{22}) = d_4$

Interaction Effect = $(d_3 - d_4)$

Thus, the interaction effect is the difference of simple effects or it is joint effect of two or more variables.

5. Factorial Designs

Factorial designs are those in which there are two or more cross classification of treatments (variables), or in which the main effects and interaction effects of two or more variables are simultaneously studied. It is a design in which two or more experimental variables may be studied simultaneously in the same experiment or in which comparison may be made simultaneously within each of number of cross-classification of treatments.

This design is an improvement over the earlier designs in the following ways:

1. In this design the main effect of two or more variables is studied simultaneously by conducting an experiment whereas in earlier design we study the main effect of one variable only.
2. In this design joint effect or interaction effect of two and more variables is studied whereas the question of interaction in earlier designs does not arise.

Layout of the Factorial Design: 3 × 2 × 2 factorial design.

Treatments A

Personality B	*Sex C*	A_1	A_2	A_3
$B1$ Extrovert	C_1 Boys	*n*	*n*	*n*
	C_2 Girls	*n*	*n*	*n*
$B2$ Introvert	C_1 Boys	*n*	*n*	*n*
	C_2 Girls	*n*	*n*	*n*

In each cell n subjects have been assigned. After the experiment the same criterion test is administered to each group. The obtained scores are analysed in the following manner.

Statistical Model

The following statistical model is used for three variables interaction effect.

The significance of *F* value is ascertained for interpreting the results and '*t*' test may be followed for specification of results.

Factorial design and method of analysis are appropriate to it which is due to R.A. Fisher is considered to be the most important contribution to the experimental technique in the present time. The factorial design involves several factors or variables or treatment classification and the number of the

subjects may differ from one level to another of the same factor. In this case the analysis is considered to be more complex for specification of the results the simple *t*-test must be followed when *F* is significant.

Comparison Between Factorial and Treatments X Treatments Levels Designs

When compared with treatments *X* levels design this design indicates that the treatments *X* levels and factorial designs have many features in common, and that, it is sometimes difficult to decide under which of this type a particular design should be classified. One variable or factor is introduced into the design basically to make possible a more precise estimate of main effect of the other factor and if the interaction effect is or only identical or secondary interest, the design may be clearly classified as a treatments *X* levels design.

In this case it is presumably known in advance that the control variable is related to the criterion variable. Hence there would be no point in testing the significance of the main effect of the control factor or variable. On the other hand, if the second variable is introduced basically in order to study and evaluate its main effect along with that of first factor and to study the interaction effect between the two then the design is clearly a factorial design. In this case it is not knowing in advance whether the second factor is related to criterion variable or not. Hence, the purpose of introducing second factor is not to increase the precision of the experiment, so far as the evaluation of first factor is concerned. It is some situations of the purpose of experiment are so mixed that one cannot readily decide how to classify the design. This is of little practical consequence so long as results are properly analyzed and interpreted, hence it is very essential on the part of researcher or experimenter to decide the design appropriately so that appropriate analysis can be done.

Analysis Variance Table

Source	*df*	*SS*	*MS*	*F*	*df*
A Treatment	a–1	SS_A	MS_A	$F_A = \frac{MS_A}{MS_w}$	(a–1), diff.
B Variable	b–1	SS_B	MS_B	$F_B = \frac{MS_B}{MS_W}$	(b–1), diff.
C Variable	c–1	SS_C	MS_C	$F_C = \frac{MS_C}{MS_W}$	(c–1), diff.
$A \times B$	(a–1)(b–1)	SS_{AB}	MS_{AB}	$F_{AB} = \frac{MS_{AB}}{MS_W}$	(a–1)(b–1), diff.
$A \times C$	(a–1)(c–1)	SS_{AC}	MS_{AC}	$F_{AC} = \frac{MS_{AC}}{MS_W}$	(a–1)(c–1), diff.
$B \times C$	(b–1)(c–1)	SS_{BC}	MS_{BC}	$F_{BC} = \frac{MS_{BC}}{MS_W}$	(b–1)(c–1), diff.
$A \times B \times C$	(a–1)(b–1)(c–1)	SS_{ABC}	MS_{ABC}	$F_{ABC} = \frac{MS_{ABC}}{MS_W}$	(a–1)(b–1)(c–1), diff.
Between cells Within	(abc–1) diff.	SS_B SS_W	MS_B MS_W		diff. = (N–abc)
Total		SS_T			

6. Group Within Treatment Design

Group within treatment designs are those in which the population to be investigated consists of a large number of finite groups and in which each treatment is administered to an independent random sample of intact group. When the purpose at an experiment is to establish generalizations about a population consisting of a large number of sub-population, this design is much less precise than other designs using the same number of subjects. But since it eliminates any possibility of contamination of one treatment by other. It is sometimes preferable to other design inspite of its lack of precision. The purpose is to study the main effect of treatment.

Treatments A

	A_1	A_2	A_3
1st Experiment	G_{11}	G_{12}	G_{13}
2nd Experiments	G_{21}	G_{22}	G_{23}
	M_1	M_2	

This design is most frequently used in education. There are three treatments which are administered in six groups of different institutions so that contamination of the treatment may not influence the main effect of the treatments. Two treatments should not be given in the same institutions. The data are analysed in the following manner:

When, $F_G = MS_G / MS_W$, is significant df– $(G–a)$. $(N–G)$

Then, $F_A = MS_A / MS_G$) df – $(a = 1)$, $(G–a)$

Analysis Variance Table

Source	*df.*	*S S*	*MS*	*F*
Treatment A Group within	a–1	SS_A	MS_A	$F_A = \frac{MS_A}{MS_W}$
Treatment G	$G–a$	SSG	MSG	$F_G = \frac{MS_G}{MS_W}$
Within Subjects	$N–G$	SSW	MSW	
Total	N–1	SST		

If F_G is not significant.

$$F_A = \frac{MS_A}{MS_W} \; df - (a-1),\ (N-G)$$

Then,

If F_A is significant 't' must be followed to specify the results.

In group within treatment design. group variation is tested at the analysis stage. Before testing main effect of treatment, significance of group variation (*SSG*) is to be tested: If group variation is significant then main effect of treatment is tested by dividing by mean group variation. If it is not then by mean subjects variation (*SSw*) as shown above.

Advantages

The following are the main advantages:

1. This design is highly applicable in educational experiments because in educational situation the more chances of more contamination effects are these because subjects are human beings.
2. Other experimental designs can control only basic type of errors but not the contamination effect. The contamination effect is eliminated by this design only.
3. In this design '*G*' -error has greater scope. This error can be eliminated by repeating the experiment or more over the group variation (*S*-error) is eliminated at analysis stage.

LATIN SQUARE DESIGNS

"The Simple Latin Square Experimental Design is one in which a different independent random sample of n subjects corresponds to each cell of the table." This type of design is known as a Simple Latin Square Design.

– E.F. Lindquist

In derives its name from an ancient puzzle, that of determining in how many different ways Latin letters may be arranged in a square table so that each letter appears once but only once in each row and each column. The following are the examples of Latin Square Designs:

A	*B*	*C*
C	*A*	*B*
B	*C*	*A*

B	*C*	*A*
C	*A*	*B*
A	*B*	*C*

There are two different ways of arranging the three letters *A, B, C.* It may be indicated 3 × 3 squares, it involves 12 different ways.

Example: Suppose that we wish in a single experiment to compare the effects on reading rate of three styles. (*A*), three size of type (*B*) and three widths of column (*C*). In a complete factorial design of this type, would require the printing of 27 different editions of the rate of reading test, each with a different combinations of size, style and widths of columns.

If we printed only nine editions, combining each style of type once with each size and only once with each width of column. We should then administer the nine editions simultaneously, each to one of nine different randomly selected groups of subjects. The main effect of styles would then be independent of the main effects of size and width, and similarly for the main effect of size or of width. This is a defective design unless one can assume that there are no interaction of the factors involved.

It is evident, then that there is no possibility of identifying or testing! individual interactions in the Latin Square. Also the use of 'residual' means square as an error term for testing main effects would be open to exactly the same objections as the use of a pooled error term in a complete design.

Confounding in Latin Square Designs

The comparison of overall treatment means in any classification would appear or would seem to be completely balanced with reference to the other factors. Actually the comparisons are truly balanced. Consider the 2 × 2 Latin Square.

	A_1	A_1	Column I	Column II
B_1	C_1	C_2	$A_1\ B_1\ C_1$	$B_1\ A_2\ C_2$
B_2	C_2	C_1	$A_1\ B_2\ C_2$	$A_2\ B_2\ C_1$

Hence the sum of squares for columns on which the estimate of the main effect of A will be based, depends on the difference between the sums of the means of the pairs of cells.

It is clear that any interaction of *A* and *C* or of *A* and *B* would also be equalized or counter balanced. The *AC* interaction effects are illustrated as follows:

		C		Column I	Column II
		*C*1	*C*2		
A	*A*1	+7	–7	+7	+7
	*A*2	–7	+7	$A_1C_1B_1$	$A_2C_2B_2$
				–7	–7
				$A_1C_1B_1$	$A_2C_2B_2$
				7 – 7 = 0	7 – 7 = 0

The effects would be completely confounding with the A effect in the column differences. The confounding means inextricably Intermingled. The full effect of these interaction would be included in the column difference as follows.

	C_1	C_2
B_1	+5	–5
B_2	–5	+5

Column I	Column II
+5	–5
$A_1C_1B_1$	$A_2B_2C_2$
+5	–5
$A_1A_2C_3$	$A_2B_2C_1$
+5+5 = 10	–5–5 = –10

	B_1	B_2
A_1	+4	–4
A_2	–4	+4

Treatments A_1 and A_2 were equally effective at each level of *B* or separately.

In general, then the *BC* interaction effect, but only this effect, is completely confounded with the *A* effect in the column difference. Similarly *AC* interaction effect is confounded with the B effect and the *AB* interaction effect is confounded with the *C* effect.

ANALYSIS OF VARIANCE FOR A LATIN SQUARE DESIGN

Suppose, for example, that one of the four subjects is tested each day at 1, 2, 3 and 4 '0' clock. The variation between the hours might be controlled by randomization that each treatment occurs not only once on each day arrangement of the treatments shown in the following 4 x 4 Latin Square. Design

4 × 4 Latin Square Design

Hours/days	*1*	*2*	*3*	*4*
1	*A*	*B*	*C*	*D*
2	*B*	*A*	*D*	*C*
3	*C*	*D*	*B*	*A*
4	*D*	*C*	*A*	*B*

After experimentation, the following observations corresponding to the cell entries are those shown as follows:

Observations Obtained with
4 × 4 Latin Square Design

Hours/days	*2*	*2*	*3*	*4*	*Σ*
1	4	3	8	2	17
2	6	1	2	4	13
3	2	4	3	1	10
4	3	2	2	3	10
Σ	15	10	15	10	50

The total sum of squares is based on the variations of the cell entries of this table-

Total = $4^2 + 3^2 + 8^2 + \quad 2^2 + 3^2 - (50^2/16) = 49.75$

The hour (column) sum of squares will be given by

Hour = $(15^2/4) + (10^2/4) + (15^2/4) + (10^2/4) + (50^2/16) = 6.25$

The day (row) sum of squares will be

Day = $(17^2/4) + (13^2/4) + (10^2/4) + (10^2/4) + (50^2/16) = 8.25$

The treatment sums are obtained by adding the cell entries for each treatment. Thus, we have-

$A = 4 + 1 + 1 + 2 = 8$

$B = 3 + 6 + 3 + 3 = 15$

$C = 8 + 4 + 2 + 2 = 16$

$D = 2 + 2 + 3 + 4 = 11$

Then the treatment sum of squares will be equal to

Treatment = $(8^2/4) + (15^2/4) + (16^2/4) + (11^2/4) + (50^2/16) = 10.25$

We subtract the sum of squares for days (rows), hours (columns) and treatments, each with 3 d.f., from the total sum of squares. We obtain a residual sum of squares with 6 df. This residual sum of squares is the error sum of squares for the Latin square design. Thus

Errors = Total – (row + column + treatment)

= 49.75 – (6.25 + 8.25 + 10.25) = 25.00

These results have been summarized to obtain the significance of treatment effects in the Latin square design.

Analysis Variance Table

Source of value	*df*	*Sum of Square*	*Mean Square*	*F*
Treatment	3	10.25	3.42	0.82
Days	3	8.25	2.75	
Hours	3	6.25	2.08	
Error	6	25.00	4.16	
Total	15	49.75		

The *F* value was obtained 0.82 with d.f. (3,6) it was not significant at any level of significance. The null hypothesis was not rejected. It may be interpreted that all the four treatments are equally effective.

DISADVANTAGES OF LATIN SQUARE DESIGN

It has the following limitations:

1. In this design the main effect of the treatments can only be studied. The interaction effects of the treatments can not be identified or it is counter balanced.
2. The main effect of the treatment design is great influenced by the confounding of the factors included in the experiment. The simple Latin Square Design has the little use in education and psychology.
3. The type of *G* errors are completely randomized with reference to cells.
4. It assumes that both intrinsic and extrinsic interaction may be negligible.

SOME COMMON ERRORS IN EXPERIMENTAL DESIGNS

Norton and E.F. Lindquist (1951) have pointed out some common errors in experimental designs

1. There is a usual failure to comply with the basic conditions of control.
2. It is generally overlooked the confounding or contamination effect on the criterion or dependent variable.
3. The criterion test is not validated in experimental settings, it is a common error.
4. There is a failure to take into account the assumptions underlying the procedure of experimentation.

5. In the analysis or treatment of data is inappropriate and inadequate statistical techniques are employed. The assumptions of the statistics are not observed.
6. The population of the study is not defined carefully to which the results are to be applied and generalized.
7. It is a common error that inappropriate and inadequate experimental designs are used to achieve the objectives of the study.
8. The researcher is not conscious enough regarding the intervening variables of the study which usually influence the criterion variable.

A researcher should attempt to minimize these common errors designing and conducting an experiment.

EXERCISES

1. Define the term 'Experiment'. Differentiate between Research Design and Experimental design.
2. Indicate the need of experimental designs in Education and Psychology. Distinguish between experimental methods and experimental designs.
3. Enumerate the essential characteristics of a good experimental design and purpose in research studies.
4. Describe the Basic Principles of Experimental Designs. Mention Basic types errors of experiment.
5. There are six Basic Experimental Designs according to E.F. Lindquist. Why these designs are known as Basic designs?
6. Differentiate between Levels X treatments designs and factorial designs and their uses in educational research studies.
7. "Group within Treatment Design is less precise design but more useful in educational studies". Justify this statement.
8. Describe the model, uses and disadvantages of Latin Square Design.

Chapter 13

Tools of Research

A great variety of research tools are of many kinds and employs distinctive ways of describing and qualifying the data. Each tool is particularly appropriate for certain sources of data yielding information of the kind and in the form that would be most effectively used. Some of these devices merely identify the presence or absence of certain aspects of a situation. Others collect qualitative descriptions which may involve comparisons or contracts between elements present in the situation. Other devices yield quantitative measure in scale measures or in scores. The measurement of what is identified adds an important dimension to description; not only what but how much is revealed.

Many of the tools of research have been designed to yield quantitative measures. Others yield description that may be refined by counts of frequency of appearance. This qualification of data is an essential part of research. While some judgement cannot be expressed in frequency counts percentages, or scores, most data are made more meaningful by qualification. In addition to frequency counts and percentage or fractional comparisons, data may be refined by numerical ratings, rank order placement, paired comparisons, social distance scales, equal appearing intervals, summated ratings and standardized score values. Some important tools of research which are most frequently used in behavioural science research have been discussed here:

1. Questionnaire,
2. Schedule,
3. Rating Scale, and
4. Tests,

1. QUESTIONNAIRE

The questionnaire may be regarded as a form of interview on paper. Procedure may be regarded as a form of interview on paper. Procedure for the construction of a questionnaire follows a pattern similar to that of the interview schedule. However, because the questionnaire is impersonal it is all the more important to take care over its construction. Since there is no interviewer to explain ambiguities or to check misunderstandings, the questionnaire must be especially clear in its working. The variety of possible answers to each question must be anticipated more fully than for an interview. The questionnaire is probably the most used and most abused of the data gathering devices.

Definition

A questionnaire is a form which is prepared and distributed for the purpose of securing responses. Generally these questions are factual and designed for securing information about certain conditions or practices, of which recipient is presumed to have knowledge. Goode and Hatt have defined questionnaire as a device for securing answers to questions by using a form which the respondent fills himself.

According to Barr, Davis and Johnson "A questionnaire is a systematic compilation of questions that are submitted to a sampling of population from which information is desired."

As the term generally used. in educational researches, "the questionnaire consists of a sense of questions or statements to which individuals are asked to respond the questions frequently asked for facts or the opinions, attitudes or preferences of the respondents."

Goode and Hatt have given an illustrated definition of questionnaire.

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

In questionnaire forms are used and the respondents fill in themselves, thus questionnaire place heavy reliance on the validity of the verbal reports. This instrument is widely used by researchers for a number of reasons.

Significance of Questionnaire

Beginners are more commonly tempted to this tool, because they imagine that planning and using a questionnaire is easier than the use of other tools. It is also considered to be the most flexible of tools and possesses a unique advantage over others in collecting both qualitative and quantitative information. Critics speak of it as the lazy man's way of gaining information, because it is comparatively easy to plan and administer a questionnaire. "As a matter of fact, preparation of a good questionnaire takes a great deal of time, ingenuity and hard work."

Common Faults

Questionnaire prepared by novices suffer from such errors as:

1. *Too lengthy*: They contain a large number of questions requiring lengthy answers.
2. *Vague*: Items are imperfectly worded and improperly arranged.
3. The proforma itself is poorly conceived and badly organized.
4. The subjects touched by the items of the questionnaire are trivial importance.

We should also beware that this device suffers from certain inherent drawbacks. These according to T.K. Kelly are:

1. It is not possible to justify the selection of the sample of respondents with demonstrable fairness.
2. Benefits of the study seldom acquire to the respondents.
3. It requires a large amount of investment on the part of the investigator.
4. The respondent may not possess the expertise required for giving the answer.
5. Educational administrators are allergic towards questionnaire since they receive a large number of them, day in and day out. The arrival of a new questionnaire irritates them as they believe that it constitutes an encroachment upon their busy schedule of work.
6. It is also wrong to imagine that questionnaire technique is a quick and easy method of investigation. On the contrary, the responses are rather slow and disappointing because of their incompleteness, indefiniteness and hostile attitude of the recipients, who feel bored by the quantum of the questionnaires, that they receive.
7. Their casual responses furnish a very flimsily basis of valid generalization.

Design of the Questionnaire

In order to gain acceptance for his questionnaire, the researcher should design an appealing format. Many unattractive questionnaires end up in a wastebasket rather in the hands of the sender. To improve the attractiveness of the instrument, choose a title that is clear, concise, and descriptive of the research project, and use well typed or printed questions that are properly spaced and easy to read. It is generally advisable to group questions of a similar nature together.

Type of Questionnaire Items

The two commonly used types of questionnaire items are the unrestricted, or open form items, and the restricted, or close form items. Each type has its advantages and disadvantages, so the researcher must decide which is more likely to yield the data needed in a particular research project.

The open formed item is also referred to as the "Open end", "Short-answer", or "Free-response" item because offer the question there is a space provided in which the respondent is asked to write his answer. This type of item permits explanation, but responses can be difficult to summarize and tabulate. The responses also may be too brief, or the respondent may have omitted important information.

The open form item is of most value when unrestricted, in depth responses are needed. An example of this type of questionnaire item follows:

In your opinion, what might your high school have done to prepare you more adequately for college?

The closed form item sometimes is referred to as the "restricted" or "structured" type. It consists of a question or a statement to which a person responds by selecting one or more choices, such as "Yes" or "No". In one variation of this type the respondent may be asked to underline award from the two or more alternatives. Another variation requires the ranking of choices.

The close form item facilities the tabulation and analysis of data. It also improves the reliability and consistency of the data. One limitation of this kind of item is that the respondent does not have the opportunity to explain why he has given certain responses, and this may be important in some kinds of research studies. The close form item also limits the scope and depth of responses, so its use in measuring attitudes, feelings and certain aspects of behaviour may be limited. It is possible also that the answers from which the respondents must choose are not the proper ones for all of the individuals who are given the questionnaire. An example of a closed form questionnaire item follows:

If group tests are used in your school, by whom are they administered?

(*a*) Administrators (*b*) Consellors,
(*c*) Psychologists, (*d*) Psychometricians,
(*e*) Teachers, and (*e*) Others

Elements of Questioning Method

In using the questioning method there are six elements to be considered :

(*i*) The content of the questioning; which includes both why the researcher is asking the questions and why the respondent believes they are being asked, since these are not necessarily the same;
(*ii*) Content of the questioning;
(*iii*) The question which can be defined as the verbal stimulus to which the respondent will be exposed;
(*iv*) The provision for answering which refers to the response the respondent will be.

(*v*) The way in which the response will be recorded, which refers to variation like writing or speaking or recording;

(*vi*) The nature of the researcher respondent interaction, which considers whether researcher respondent interaction, which considers whether researcher and respondent actually meets face to face or whether they communicate impersonally.

Preparing and Administering the Questionnaire

1. Get all the help that you can in planning and constructing your questionnaire. Study other questionnaire and submit your items for criticism to other member of your class or your faulty, especially to those who have had experience in questionnaire construction.
2. Try out your questionnaire on a few friends and questionnaires when you do this personally, you may find that a number of your items are ambiguous.
3. Choose respondents carefully. It is an important that questionnaire be sent only to those who possess the desired information or those who are likely to be sufficiently interested to respond conscientiously and objectively. A preliminary card, asking whether or not the individual would be willing to participate in the proposed study, is recommended by research authorities.

   In a study on questionnaire returns see (1) discovered that a greater proportions of returns was obtained when the original request was sent to the administrative head of an organization, rather than directly to the person who had the desired information. It is possible then when a superior officer turns over a questionnaire to a staff member to fill out, there is implied some feeling of obligation.
4. If schedules or questionnaires are planned for use in a public school, asking for the responses of teachers or pupils, it is essential that approval of the project be secured from the principal, who may, then, wish to secure approval from the superintendents of schools.
5. If the desired information is delicate or intimate in nature, consider the possibility of proving for anonymous responses. The anonymous instrument is most likely to produce objective responses. There are occasions, however, for purposes of classification, when the identify of the respondent is necessary. If a signature is needed it is essential to convince the respondent that his responses will be held in strict confidence, and that his answer will in no way jeopardize the status and security of his position.
6. Try to get the aid of sponsorship. Recipients are more likely to answer if a person, organization, or institution for prestige has endorsed the project.
7. Be sure to include a courteous, carefully constructed cover letter to explain the purpose of the study. The letter should promise some sort of Inducement to the respondent for compliance with the request.

   The cover letter should assure the respondent that delicate information will be held in strict confidence. The explanation sponsorship might well be mentioned, of course, a stamped addressed return envelope should be included. To omit this courtesy would be practically to guarantee that many of the questionnaires would go into the waste paper basket. It has been suggested that two copies of the questionnaires be sent, one to be returned when completed and the other for respondent's own life.
8. Recipients are often slow to return completed questionnaire to increase the number of returns, a vigorous follow up procedure may be necessary. A courteous postcard reminding the recipient that the completed questionnaire has not been received will bring in some additional

responses. This reminder will be effective with those who have just put in the follow up process may involve a personal letter or reminder. In extreme cases a telegram, phone call, or personal visit may bring additional responses.

It is difficult to estimate, in the abstract, what percentage of questionnaire responses is to be considered adequate or satisfactory. The importance of the project, the quality of questionnaire, the case used in selecting recipients, the time of year, and many other factors may be significant in determining the proportion of responses. Needless to say, the smaller the percentage of responses, the smaller the degree of confidence one may place in the adequacy of the data collected. However, objectivity of reporting requires that the proportion of responses received should always be included in the research report.

Choosing the Questions

Stage in a question is to define the problem precisely. It is desirable also to define at an early stage the population to whom the question is to be directed and to decide the nature of the sample to be drawn, as this may influence the drafting of the question. The definition of the problem should set out one by one the aspects of the problem to be explored and stage, II, follows on from this with construction of questions or items to deal with each aspect in turn. The question should be compiled with definite hypotheses or theories in mind. Each question should contribute clear information on a specific aspect to be explored or else the question should be discarded ruthlessly.

If the investigation is on a small scale and the investigator himself will classify all the responses, it may not be necessary to put all questions into a multiple choice pattern. Multiple choice can be tiresome, especially if the alternatives offered for choice do not express adequately the response a subject wishes to express opinion questions if they are included must not be too general or they will be unclassifiable and should be restricted to fairly straightforward topics where answers can easily be coded subsequently.

It may be necessary to choose questions and to specify possible answers in such a way as to facilitate coding. The art of drafting a question consists of being able to do this without forcing your respondents into an uneasy choice a difficulty which they can too easily resolve by giving up altogether.

The questionnaire should start with simple factual questions, so that the person completing it gets off to a good start. Complex or awkward topics should come towards the end. An open ended- general question at the end will allow expression of points which the responder thinks important, though they are not covered by the questionnaire.

A questionnaire need not to be restricted to questions attitude scales ratings and check lists may be included, providing they are brief and straight forward and the instructions are kept simple. Similarity and brevity are cardinal virtues.

The distinctions between a leading question and a neutral question is sometimes difficult to decide. For example, which of following is a neutral wording.

1. Are you in favour of abolishing corporal punishment?
2. Should corporal punishment be abolished?
3. Should corporal punishment be retained etc.?

The questionnaire is not a scientific instrument. It is a cheap, easy and rapid method of obtaining information and non- information one never knows which he points the weaknesses of both questionnaire and interview-the tested-validity of the responses. Questionnaires show what people say, not what do or are. Any form of questionnaire implies a certain frame of reference and thereby influences the answer given.

Try out of the Questionnaire

It is very helpful to obtain criticism of qualified persons about the questionnaire before the final form is got printed and mailed out. The investigator may request some of his friends to look over the items critically with the idea of discovering possible misinterpretations. A few copies may then be got typed and sent or administered personally to a random sample of the respondents. Their responses must be carefully examined to see if they suggest any modifications of the questionnaire before it is used on a large sample or for study purpose. This presetting of all the measuring tools is essential to ascertain the workability of the tool. Different persons will differently interpret the same lines. A preliminary form of the questionnaire used in this way will require revision and improvement by eliminating some of the items. It may also suggest addition of some more items. The result of the try out should also be analysed in a preliminary way to determine whether they lead to certain conclusions for the significant purpose of the study. The presetting of a questionnaire indicate the following things:

- Relative effectiveness and costs of alternative questions instruments and procedures.
- Acceptability and intelligibility of the questions from the respondents point of view.
- Completeness of questions for correct coding and interpretation.
- Response rates and estimates of mean and variance.

Improving Questionnaire Items

The questionnaire maker must depend on words alone. It is apparent that he can not be too careful in phrasing questions to insure their clarity of purpose. While there are no certain ways of producing full proof questions, there are principles that might be employed to make items more precise. A few are suggested with the hope that students constructing questionnaires will become critical of their first efforts and strive to make each question as clear as possible.

1. Define or qualify terms that could easily be a misinterpreted. “What is the value of your horse? The meaning of the term value is not clear. These values may differ considerably. It is essential to frame specific questions such as, “what is the present market value of your horse?”
2. Be careful in using descriptive adjectives and adverbs that have no agreed-upon-meaning. This fault is frequently found in rating scales as well as questionnaire.
3. Beware of double negatives (1) Federal aid should not granted for those states in which education’ is not equal regardless of race, creed, or colour.
4. Be careful of inadequate alternatives (1) Married? Yes/No.
5. Avoid the double barreled question.

   Example: Do you believe that gifted students should be placed in separate groups for instructional purposes and assigned to special schools?
6. Underline the word if you wish to indicate special emphasis. Example
7. Should all schools offer modern foreign language?
8. When asking for ratings or comparisons a point of reference is necessary.

   Example: How would you rate this student teacher’s class room teaching? Superior Average-Below Average.

Phrase questions so that they are appropriate for all respondents. Design questions that will give a complete response. Such questions which as answer “Yes or no” would not reveal much information about the reading habits of the respondents.

There must be a provision for the systematic quantification of response. One type of question that asks respondents to check a number of items from a list is difficult to summarize especially all respondents do not check the same number. The students should bear in mind that these suggestions are used in constructing questionnaire items.

Scope of Questionnaire

In descriptive studies where the sources are varied and widely scattered, the questionnaire is a major instrument for gathering data. It is very handy in cases, where one cannot conveniently see personally all the people from whom the responses are required. This technique finds favour in determination of present status in certain aspects of education-current practice in schools, financial aspects service conditions of teachers, etc. It can be used over extensive range of territory-national and international. "As research techniques are becoming more and more refined day after day, it is hoped that this wayward child of the science of education will soon curb its unruly disposition and also mend its unseemly ways".

Characteristics of a Good Questionnaire

The following are the characteristics of a good questionnaire

1. The covering letter of the questionnaire is drafted in a befriending tone and indicates its importance to the respondents.
2. The questionnaire contains directions which are clear and complete. Important items are clearly defined and each question deals with a single idea defined in unambiguous terms.
3. It is reasonable short, through comprehensive enough to secure all relevant information.
4. It does not seek information which may be obtainable from other sources such as school records and University results.
5. It is attractive in appearance, neatly arranged, clearly duplicated and free from typographical errors.
6. It avoids annoying or embracing questions, which arouse hostility in the respondent.
7. Items are arranged in categories which ensure easy and accurate responses.
8. Questions do not contain leading suggestions for the respondents and are objective in nature.
9. They are arranged in good order. Simple and general questions should precede the specific and complex ones. Questions that create favourable atmosphere should precede those that are personal and touch delicate points.
10. They are so worded, that it is easy to tabulate and interpret the responses. It is always advisable to base them upon a preconceived tabulation sheet.

Suggestions for Construction of a Good Questionnaire

1. The first thing to consider is the psychology of the respondents. His willingness, honesty and ability to answer questions are of utmost importance. He is usually a stranger, who is neither interested in the investigator nor in his project. He may be a very busy person, and his administrative responsibility may be making heavy demands on his time. The investigator must put himself in the respondents position to see how his attention, sympathy and cooperation can be secured. He should also try to minimize the demands on his time.
2. One can make the responses simple by providing a variety of possible answer and requiring the respondents to put a check mark against the correct one.

3. One should not undertake a questionnaire study, unless the problem is really important from the point of view of others. It should appear to be worth investigation to the respondents. It should always be accompanied by a brief introductory letter which will explain the purpose of investigation and show how the respondent's cooperation will benefit him or a noble cause. It should also contain suitable instructions for filling in it.
4. Efforts should be made eliminated irrelevant items, which may not be helpful in interpretation of results. Weeding out of unnecessary and trivial questions for making the questionnaire as brief as possible is very important. Experience shows that in this way the number of questions can in certain cases be reduced to one half.
5. In framing the questionnaire the situation in which the average respondent works should be taken into average respondent works should be taken into consideration. It is frequently noticed that questionnaires are prepared with reference to institutions of smaller size or with reference to institutions which are financially or otherwise more happily placed and these are institutions of smaller size where those conditions do not prevail. Thus the responses are irrelevant and useless.
6. The importance of each question i.e. what is actually required must be clear to the maker as well as the recipient. All the items must be free from technical and ambiguous terms so that the recipients can give their responses without consulting others. If any technical terms have to be used they must be explained in the body of the questionnaire.
7. As far as possible the response should be of such a nature as can be easily summarized in some form. However, they need not necessarily be quantitative or of yes or no character, or check mark type. These are preferable; because they are easier to summarize.
8. Questions eliciting opinion should be avoided unless opinion is worth getting. Questions permitting subjective responses should be minimized.
9. Where the responses are too large to be counted, it is always advisable to resort to coding symbols, which can be punched and weighed for summarizing purposes.
10. The group to whom a questionnaire is administered must be judiciously selected. One must carefully avoid asking people questions, they do not know or about which they have strongly coloured convictions. Sometimes the respondents may possess the information required, but he may not be free or willing to divulge it. Asking people working in denominational institutions on the eve of vacation whether they would return to work after vacation, may not beget truthful replies. In such cases asking respondents not to append their signatures would be helpful in getting frank responses.

    If there is any doubt that correct information about certain items will not be forthcoming from all the respondents questions about such items should not be asked if the investigator wants to avoid landing himself in difficulties at the interpretation stage.
11. A good questionnaire will arouse the curiosity as regards results and will stimulate them to make supplementary inquiries and promise them a copy of the published results.
12. It should be so organized as to avoid overlapping of items in different sections.
13. Evidently respondents will not like to incur expenditure on postage for returning the questionnaire. The investigator should therefore see that it accompanied by self-addressed stamped envelope, in case, it is to be returned by post.

Limitations of the Questionnaire Technique

In this technique, a research worker has to depend on several hundred persons from whom response is expected and it is not an easy job to get active and willing cooperation of all the respondents. One may be very diligent and sincere about his work but one can not be sure that the responses would be forthcoming. Some of the respondents may hold back their replies because they are skeptical about the value of research, others may not respond for want of time, or because they do not feel interested in the problem in hand or because they have not been sufficiently motivated by the introductory letter. The research worker may therefore remain in a state of expectancy and his work may be delayed.

1. Even when he gets back a sufficiently large number of questionnaires, he may find that all of them have not been completely filled in Omissions in some cases may be such as will materially vitiate the results and significantly affect the interpretations.
2. If the questionnaire is sent to different areas or to people of different categories and one set of respondents deliberately with holds its responses, the inquiry would be affected adversely. Suppose there is a judicial inquiry on discrimination against a minority and section of the minority concerned refuses to cooperate as a protest, evidently the results of the inquiry will not present a true picture.
3. Sometimes the respondents fill in their responses very indifferently, without bothering about their correctness and sometimes they deliberately give wrong information.

2. SCHEDULE

Scheduling is defined as the translation of the developed plan a time table, showing the calendar date for the start and completion of work. The scheduled start and end of each activity or work package as well as the total project is emphasized. The schedule helps to determine the operating is emphasized. The schedule helps to determine the operating budget for the project and permits us to allocate resources to' the activities.

It is within the scheduling process that we become concerned with competition for one or more of the resources that may exist in an organization. In establishing a schedule for the project, we are concerned not only with the time to do a job but also with the exact data that the office involved may be able to do our work, having considered all the other projects in the organization that will utilize this same resources. The planned schedule, which is generated as an output of the scheduling process, enable the project director to judge event progress and forecast a data of completion. The scheduling' process also enables the project director to inform various organizational units of the schedules that they must maintain for their particular task.

Some Scheduling Constraints

On the surface, the process of scheduling appears relatively simple. Several constraints, however, make the process somewhat difficult and often lead to the development of less than an ideal or optimum schedule. Some constraints are given in the following list:

1. The availability of particular resources during specific calendar periods.
2. The general sequence of the work in the project plan.
3. Consideration of resource requirements of other present or future projects.
4. Different or conflicting demands on the same resource.

5. A desire to avoid peak load for particular skills.
6. The available local capacity to do a particular task.
7. Limitations and requirements imposed by funding agencies.
8. Desire to minimize overtime and idle time.
9. Necessary integration with other plans or projects using the same resources.
10. The manager's judgement of a reasonable time for performing activities of an uncertain nature.
11. Technical constraints such as uncertainties which may require extra time.
12. Local personnel policies concerning work practices (vacations, sick leave, etc.)
13. National, states, and local laws governing work practices.
14. Difficulties inherent in scheduling far in advance.
15. The varying number of working days in a month and their translation into calendar dates.

Many of these constraints relate to project scheduling in the business-military complex, but have some application to the educational situation. The educational situation, in contrast, has some unique constraints which can affect schedules. Notable among these is the nine to ten month period in which educational personnel operate.

Characteristics of a Good Schedule

Unfortunately, an Ideal or optimum schedule rarely can be prepared in a practical situation. Instead, the project manager must generate a "reasonable' schedule. In doing so, he must form the criterion of reasonableness. Some possible criteria are: (1) to complete the project in a minimum amount of time: (2) To complete the project with a minimum amount of cost: (3) to maximize performance in the project. A further criterion might be to "level" the utilization of resources over a period of time. A schedule that is developed for only one of these criteria probably will not meet the needs of the criterion.

The most typical criterion is the one associated with the least cost, i.e. schedules are prepared to minimize the costs that are associated with the resources used in the project.

Scheduling Steps

Designing a schedule begins with the individual activities and work package. Giving consideration to the resource availability, a scheduled elapsed time may be shorter/longer that the estimated time for the activity. A schedule end date can be determined for the terminal event, if a schedule start date has been provided. Forward and backward time calculations can be used to establish the earliest schedule completion dates and the latest schedule completion dates for each event, as we did in the time estimating phase.

If, upon completion of this step, the total time exceeds the time available or the total costs are exceeded, readjustments will have to be made, using the procedure of paralleling activities, eliminating tasks, redefining work scope, and adjusting resources. The adjustment continues until a schedule is devised that meets the criterion established by the manager.

In developing the schedule, the manager should realize the slackness existing on the pathways, in the work flow. If the manager is aware of how much and where slackness activities on non-critical paths can be moved until resources are available; their duration can be extended in order to reduce resource utilization during a given period of time, or even possibly split into segments for different

scheduled periods. Splitting into segments can only be done when it is possible to complete the task in segments. The activities on the critical path are not changed unless it is absolutely necessary.

Rescheduling

Once the project is initiated and operations are begun, the project will need to be rescheduled from time to time. The project manager should not assume that the initial schedule will be maintained throughout the life of the project. This condition could be desirable but schedules can be disrupted for many reasons. A change in the major or supporting objective of a project may lead to a rescheduling of the project internally.

Another factor that may cause rescheduling might be change in the work flow necessary to achieve an objective. The schedule may have to be changed because of certain slippages which have occured because of unusual delays in completing an activity, or because of increase in slack time due to the early completion of an activity. Another cause of rescheduling may be change in funding. The funding may go higher or lower. In either case, a different schedule may have to be generated.

Problems in Scheduling

There are four different problems associated with the scheduling process. Several general problems appear to give the most concern to project directors these four problems have been the object of research and study. Each of them will now be discussed briefly.

1. *The Fixed Duration Time of Problem*

This scheduling problem arises when there is a constrain upon the total project duration time. That is there is a fixed time by which the project must be completed. This situation usually arises and others have pointed out, when the project manager has produced sufficient resources to carry out the project but wishes to carry them at a constant rate, making the most effective use of them. This concept is often referred to as “manpower leveling”.

2. *The Fixed Resources Problem*

This scheduling problem arises when a project managed has a pool of resources which can not be exceeded. His objective is to schedule the activities in a way that minimizes any possible increase in the total project time. He should realize that, because of the limitations on resources, the project will have to be extended by some small amount, but this increase must be kept to a minimum.

The solution of this problem lies in the following steps; Activities on non-critical pathways throughout the project are delayed until the manpower needed for them is available. Activities on the various slack pathways or non-critical paths are also lengthened. Instead of taking one week to do the job, perhaps two weeks are scheduled with the resources in effect for half of that activity. If the resource requirement is still excessive after these two procedures have been employed the critical path should be examined to determine the greatest reduction in resource requirements per unit of time increase in the project duration.

3. *The Time/Cost Trade off concept Problem*

Scheduling can become a major problem if either time or resources are constrained to certain limits. Some of the specific scheduling models do not take into account limited resources. Therefore, they do not as useful as scheduling techniques. If there are no constraints on either resources or time, the problem becomes at time/cost trade off. The concept has limited value in education research and development situations. Its greatest application has been made in the construction industry and other trades where there is enough data accumulated about the time and cost associated with a particular job.

4. *Multi-Project Scheduling Problem*

We have been discussing scheduling as it relates to a single project directed by one project manager. In many organizations, several projects go on simultaneously under different project managers. These projects draw upon several common resources of the organization. consequently conflicts arise about the utilization of the resources. The employment of the previous procedures makes the work flow for a particular department more even and insures that the work of the projects will be accomplished according to the schedule.

Limitations of a Schedule

The following are the main disadvantages of a schedule:

1. It is very time consuming and costly instrument in administering to the subject personally.
2. Sometimes some subjects have several time queries about the schedule and difficult to explain and satisfy them.
3. Some subjects are to be conducted to get-data.
4. Some of the subjects e.g. principals administrators are not easily approachable and get appointment for administering tool.
5. Sometimes subjects are more alert or intelligent than the researcher. Researcher has the difficulty to administer the tools.
6. On a large sample of subjects this tool can not be used effectively and easily.

3. RATING SCALES

Rating is the term applied to the expression of opinion or judgement regarding some situations, object, person etc. These opinions are usually expressed on a scale or by categories of values, either quantitatively or qualitatively. For example, a teacher in assigning a mark or a grade to a pupil is applying a rating scale of proficiency of some sort to that pupil, or an individual in filling out a recommendation form for another person for a teacher's placement. Rating scales are probably one of the more commonly used scaling traits and attributes.

The rating scale in values qualitative description of a limited number of aspects of a thing or of traits of a person. The classification may be set up in five or seven categories in such terms as:

1	2	3	4	5
(*a*) Superior	Above Average	Average	Fair	Inferior
(*b*) Excellent	Good	Average Below	Average	Poor
(*c*) Always	Frequently	Occasionally	Rarely	Never

"The rating scale typically directs attention to different parts or aspects of the thing to be evaluated, but does not have as many items or categories as the check list or score card." – *Good and Scates*

"Rating is an essence, directly observation", – *Ruth Strang*

A rating scale ascertains the degree, intensity, or frequency of a variable." – *Von Dallen*

"Rating is a term applied to expression of opinion or judgement 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." *– A.S. Barr*

A rating scale is a method by which we systematize the expression of opinion concerning a trait. The ratings are done by parents, teachers, a board of interviewers and judges and by the self as well.

There are two characteristics of a rating scale:

1. Description of the characteristics to be rated, and
2. Some methods by which the quality, frequency or importance of each item to be rated may be given.

These rating scales give an idea of the personality of an individual.

Advantages of Rating Scales

The following are the main advantages of rating scales:

1. Helpful in writing reports to parents.
2. Helpful in filling out admission blanks for colleges.
3. Helpful in finding out students' needs.
4. Helpful in making recommendations to employers.
5. Helpful in supplementing other sources of undertakings about the child.
6. Helpful in their stimulating effect upon the individuals who are rated.

Limitations of Rating scales

The following are the disadvantages of the rating scales:

1. People differ markedly in their ability to make ratings.
2. People differ in their reliability as subjects for ratings. Some are easier to rate than others. It appears that poor employers tend to be better analysed than are good ones.
3. Raters having one form of contact with the individual being rated (teachers of the same school subject) tend to agree more closely than do raters with more diversified contacts. By the same taken rating obtained from persons having predominantly one type of contact are much less useful outside that specific field.
4. The average or medium rating of a number of judges is superior to that a single judge, provided there not great differences in the capability of judges.
5. Immediate emotional reactions affect ratings.
6. Self-rating tend to be too high on desirable traits and too low on undesirable traits.
7. One tends to rate one's own sex higher than the opposite sex on desirable traits.
8. While close associates are likely to rate more reliably than are casual associates, long and intimate friendship bring marked decreases in the reliability of ratings. Persons tend to over-rate intimate friends all desirable traits and under-rate less desirable traits.
9. 'General all round value' is frequently more reliably rated than are some of the more specific qualities involved.
10. Raters are frequently unable to justify ratings, or, are apt to give absurd rationalizations.

"The design of the rating technique must always take into account the existence of three elements; the judges who will do the rating, the phenomena to be rated, and the continuum along which they will be rated. If the design does not adequately define all three, as well as assure that (1) the judges, (2) The subjects, and (3) the continuum are logically related, them only unreliable and invalid results can be expected. All three components must be very carefully selected. According to Goode and Hatt".

Traverse Suggests the Following Rules for the Rating Process

1. Define several points on each scale with as great precision as possible.
2. Restrict each rating scale to a narrow range of behaviour that can be well defined.
3. Change the ends of the scale so that the 'good' end is not always at the top or always at the bottom of the scale.
4. Avoid words such as average in the middle range of the scale. The rater who does not wish to give too much effort to the rating procedure is likely to class too many as 'average'.
5. In the directions, indicate the need for honest rating, and wherever possible, state that low rating will not have only consequence for the person rated, either direct or indirect.
6. Assure the rater that his anonymity will be safeguarded.

Principles Governing Rating Scales

1. The specific trait or mode of behaviour must be defined properly. For example, if we want to rate a child's originality in performing a task, first of all we must formulate a definition of 'originality' in behaviourable terms and then try to rate it.
2. The scale should be clearly defined i.e. we are rating at a three; or five-points scale.
3. The trait to be rated should be readily observable.
4. Uniform standards of rating scale should be observed.
5. The rater should observe the rates indifferent situations involving the trait to be rated. This will bring reliability to the Judgement of the rater.
6. The number of characteristics to be rated should be limited.
7. In the rating scale card, some space may be provided for the rater to write some supplementary material.
8. The directions of using the rating scales should be clear and comprehensive.
9. Several judges may be employed to increase the reliability of any rating scale.
10. Well informed and experienced persons should be selected for rating.

Errors in Rating

(*a*) *Generosity Error*

Sometimes raters would not like to run down their own people by giving them mow ratings. The result is that high ratings are given in almost all cases such an error is known as generosity error.

(*b*) *Stringency Error*

The opposite of generosity error may be called stringency error. Some raters have a tendency to rate all individuals low.

(*c*) *The Halo Error*

'Halo' means a tendency to rate in terms of general impressions about the rate formed on the basis of some previous performance.

(*d*) *The Error of Central Tendency*

There is a tendency in some observers to rate all or most of the rates near the midpoint of the scale. They would like to put most of the rates as 'Average' etc.

(*e*) *The Logical Error*

Such an error occurs when the characteristics or the trait to be rated is misunderstood.

Types of Rating Scales

The following are the main types of rating scales:

1. *Descriptive Rating*

The rater puts a check (Ö) in the blank before the characteristic or trait which is described in word or phrase.

Example:

Has this pupil initiative?

. . . . . Shows marked originality.

. . . . . Willing to take initiative.

. . . . . Quite inventive.

. . . . . On the whole unenterprising.

. . . . . Very dependent on others.

2. *Numerical Scale*

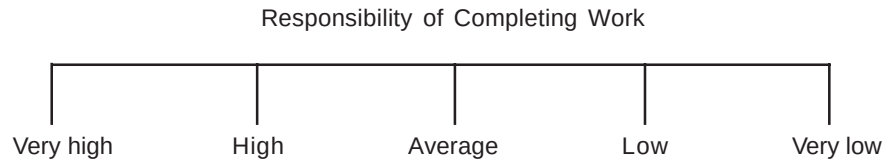
Here numbers are assigned to each trait. If it is a seven-point scale, the number 7 represents the maximum amount of that trait in the individuals, 4 represents the average amount.

3. *The Graphic Scale*

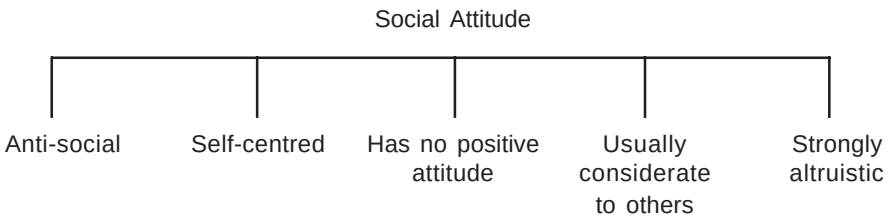
This is similar to the descriptive scale and the difference lies only in the way it is written. This is also called "Behavioural Statement Scale." These are of two types:

(*a*) Simple Scale

Example:



(*a*) Example:



4. The Percentage of Group Scale

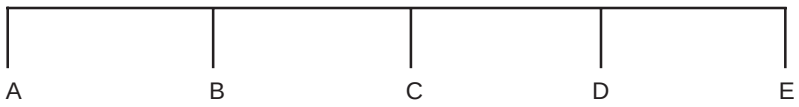
Here the rater is asked to give the percentage of the group that possesses the trait on which the individual is rated. For example, for rating the self-confidence of an individual, the rater may check one of the following:

. . . . . Falls in the top 1 per cent.
. . . . . Falls in the top 10 per cent, but not in the top one per cent.
. . . . . In the top 25 per cent but not in the top 10 per cent.
. . . . . In the top 5 but per cent not in the top 25 per cent.
. . . . .. In the lower half, but not in the bottom 25 per cent.
. . . . . In the bottom 25% but not in the bottom 10%.
. . . . . In the bottom 10% but not in the bottom 1%.
. . . . . In the bottom 1 per cent.

5. Man To Man Scale

An individual is asked to rate the ratee by comparing him to the person mentioned on the scale and assuming the ratee his position. For example, ABCDE are the persons who have been already rated is very persistent. Every one not easily stops, works quite steadily, somewhat changeable, and gives up easily.

Example: Is he generally a persistent person?



Because of subjectivity element, the use of this type is very limited.

The Score Card

This is similar to the rating scales and usually provides for the appraisal of a relatively large number of aspects in numerical terms. It yields a total weighted score as the presence of each characteristic of aspect, or the rating assigned to each, has a predetermined point value. The rater is provided with a general standard of criteria in detail and he is asked to rate only a single unit of the total situation at a time. The general practice is to employ a number of rates and their scores combined and averaged.

Scaled Specimens

Certain standards of performances are evaluated through specimens. A number of graded samples are provided by Thorndike's hand-writing scales to which one may compare the handwriting to be evaluated. These are various intelligence test scoring manuals which provide scaled specimens for determining the mental age of children as revealed by their drawings.

The Opinion or Attitude Scales

Purpose: Attitude scales have been designed to measure attitudes of an individual or group of people towards issues, institutions and group of people (such as capital punishment, teacher training, religious education in schools, etc.).

Difference between 'Attitude' and 'Opinion'

The terms opinion and attitude are not synonymous though they are allied terms.

Attitude is what a person feels or believes in. In fact it is the inner feelings of an individual which is difficult, if not impossible to describe.

Opinion is what a person says about his attitudes towards some phenomenon the research work must depend upon what the individual says to his beliefs and feelings. We obtain a sample of the opinion of an individual through the use of questions or by getting an individual's expressed reaction to statements of opinion.

Limitations

The following are the limitations:

1. An individual may express socially acceptable opinions and conceal his real attitude.
2. An individual himself may not be clearly aware of his real attitude.
3. An individual may never have been confronted with a real situation to discover what is real attitude towards a specific phenomenon was.
4. Attitudes are revealed through the behaviour of an individual. But behaviour itself is not always a true indication of attitude. Observation of behaviour may not always be possible when a large sample is under study.
5. Social custom or the desire for social approval may make many kinds of behaviour mere formalities which are quite unrelated to the inner feelings of an individual.

However, psychologists and sociologists, under the assumption that description and measurement of opinion is closely related, to the real feelings or attitudes of an individual, have devised several methods:

1. An individual is directly asked how he feels about a subject. Techniques employed for this purpose are a schedule, a questionnaire or the interview process.
2. An individual is asked to indicate his degree of agreement or disagreement with a series of statements about a controversial topic.
3. An individual is asked to check the statements in a list with which he is in agreement.
4. The attitude of an individual is inferred from his reaction to projective devices through which he reveal his attitude unconsciously.

Thurstone's Method and Likert's Method

The two most frequently used methods for the measurement of social attitude. 'The method of summated ratings' developed by Likert.

The first method since it appearance in monograph published by Thurstone and Chave in 1929 and until 1932, when the Likert method appeared, had almost a perfect over other techniques in this field.

Thurstone's Rating Scale or the Method, of Equal Appearing Intervals.

A variety of statements expressing various points of view towards a particular issue are collected, screened and edited in accordance with certain informal criteria to omit the confusing and number of judges (fifty or more) who are asked to sort them into a number of categories usually eleven to represent a scale rating form extremely favourable through neutral to extremely unfavourable expressions of opinion about the issue in question. It may be noted that the judges are asked not to express their

opinion but sort them at their face value. Tabulations are made which indicate the number of judges who placed each item in each category. The next steps consists of calculating cumulated proportions for each item and olives are constructed. Scales values of item are read from the olives, the values of each item being that point along the base line, in terms of scale value units above and below which 50 per cent of the judges placed the item.

Q values provide the statistical criterion for the ambiguity of items. 20 to 22 items are selected for the final test on the basis of the scale and a values retaining Iowa values and with scale values falling at relatively equally spaced distances along the continuum. This enables us to construct two comparable forms of the scale in terms of the scale and a values. A new groups is asked to check the statement In the form with which they agree. The score of the individual is the mean or medium scale value of the items, which he has checked for agreement. Reliability of the scale, is found by correlating scores on the two forms of the scale.

The Likert Method of Summated Ratings

This method does away with the necessity of submitting items to the judges. After editing the items are given to a group of subjects for responding to each one in terms of their agreement or disagreement. the number of favourable and unfavourable statements should be approximately equal. Usually a 1-5 scale of response is used. A score is given for each item depending upon the response made, a sum of these scores gives the individual score. Final selection of items is done on the criterion of internal consistency.

Usually Two Methods are Adopted to Analyse these Scales

(*i*) A simple way is to indicate the percentage of responses on each time.

(*ii*) The actual Likert Scaling Technique has a five point scale position being assigned to a scale value. All favourable statements are scored from maximum to minimum as:

Statement	*Scale Value*
(*a*) Agree	5
(*b*) Tend to agree	4
(*c*) Cannot say	3
(*d*) Tend to disagree	2
(*e*) Disagree	1

For statement opposing the position, the items would be scored out in the opposite order as 1, 2, 3, 4, 5.

In an opinionnaire consisting of 30 items the following score values would be revealing.

Most favourable response possible, $30 \times 5 = 150$.

A neutral attitude, $30 \times 3 = 90$ and so on.

Thus, the score of any individual would fall between 30 and 150.

Relative Merits of the Two methods

The Likert method succeeded the Thurstone method and was considered an improvement over the latter. Justifying the need for devising a new method Murphy and Likert point out “A number of

statistical assumptions are made in the application of his (Thurstone's) attitude scale e.g. that the scale values of the statements are independent of the attitude distribution of the readers who sort the statements assumptions which as Thurstone points out, cannot always be verified. The method is more over laborious. It seems legitimate to Enquirer whether it actually does its work better than the simple scales which may be employed and the same breath to ask also whether it is not possible to construct equally reliable scales without making unnecessary statistical assumptions."

The main contention of Murphy and Likert regarding the method of summated rating seems to be:

1. "It avoids the difficulties encountered using the judging group to construct a scale."
2. "The construction of an attitude scale by the sigma method (later replaced by the even simpler 1-6 method) is much easier than by using a judging group to place the statement in piles from the scale values must be calculated."
3. "It yields reliabilities as high as those obtained by other techniques with fewer items."
4. "It gives results which are comparable to those obtained by the Thurstone method."

There seems to be agreement on the simplicity of the Likert method and the time needed for its construction. It is less laborious than that developed by Thurstone.

Bird objects to such a proposition. In his opinion if the total work is taken into consideration Likert Scales with more than 25 items taken as much time as Thurstone in finding the scores. Moreover, according to him, time is no factor to be considered when it is question of the refining of the tool.

Hints on Making Opinionnaire Items

1. A careful study may be made of the list of statement prepared and used for measuring attitude by investigators in related areas of research.
2. Available literature may be surveyed thoroughly.
3. Various individuals may be requested to express their opinions about the phenomenon orally or in writing.
4. Favourable and unfavourable statements may be collected from these sources. The research worker should avoid inventing statements.
5. It is better to collect a large number of statements that are needed for the research worker for preparing an attitude scale.
6. The following types of statements should be selected :
   (*i*) Statements presenting as wide a variety of situation as possible.
   (*ii*) Statements which prevent the individual from detecting the nature of attitude which Is being evaluated.
   (*iii*) Statements which have provided to be unambiguous in their meanings through a pilot study.
7. Statements should be arranged in a random system irrespective of their favourable or unfavourable indications.
8. Approximately an equal number of favourable and unfavourable statements may be kept.

4. TESTS

In educational research achievement tests are most commonly used. These tests are of two types: Norm-referenced tests and Criterion-referenced tests. A brief description has been given here:

Criterion Referenced Tests

In the 1960s a new term entered in the vocabularies of measurement specialists, criterion-referenced test. It referred to a particular kind of test and on unconventional approach to the measurement of educational achievement. Tests of this kind were also referred to as objective-referenced or domain-referenced and were contrasted with the more conventional standardized or teacher-made tests, which are referred to as norm-referenced tests.

Strong advocates of the new tests, who were usually rather critical of conventional tests, claimed that criterion-referenced tests constituted a significant and generally applicable improvement in conception and methodology of achievement testing. They suggested that norm-referenced tests be abandoned as quickly as possible in favour of the new type. An alternative view, which we support, is that neither type is superior to the other for all measurement purposes. Each has special characteristics that make it uniquely well suited to particular situation and uses.

One way of becoming familiar with the characteristics of criterion-referenced tests is to consider some of the ways in which they differ from, or are similar to, norm-referenced tests. Comparisons of this kind are bound to involve some over simplifications and in accuracies, since there are many different forms of each type of test. Never the less, the forms have enough features in common to. make the comparisons useful, even if not always completely accurate.

Difference Between Criterion and Norms Referenced tests

One difference is in the kind of information they are intended to provide. Criterion-referenced tests are used to determine which of certain specified objectives of instruction a particular pupil has attended. Norm-referenced tests are used to determine how much overall knowledge of some subject a particular pupil has achieved. The basic report of results from a criterion-referenced test is a basic report for a norm-referenced test is a count of the number of test questions that were answered correctly.

A second difference is in the basic for interpreting the information provided the criterion in a criterion-referenced test is the attainment of all instructional objectives. The excellence or deficiency of a particular student's achievement in learning is judged by the proportion of the prescribed objectives the student has attained. The 'norm' in a normal referenced test. The excellence or deficiency of a particular student's achievement in learning is judged by the student's standing among those in the specified group.

A third difference is in the distribution of terms over the domain of achievement sampled by the test. The items in a criterion-referenced test cluster around a limited number of specific objectives. For example a criterion-referenced test might focus on 20 distinct objectives, using five items for each objective in order to determine whether or not the student had attained it. The result would be a 100 items criterion-referenced test. The items in a norm-referenced test would be diffused more widely across the domain of learning. Each of the 100 items would involve a separate aspect of achievement.

A fourth difference is in the use made of the test information. The purpose of norm-referenced test score is simply to indicate a student's degree of success in learning of criterion-referenced test, on the other hand, is after used with instructional procedures intended to ensure that certain things will be learned.

Despite these major differences, there are substantial similarities between criterion-referenced and norm-referenced tests. Both have essentially the some job to do, that is, to measure achievement in learning. Elements of quality are essentially the some for both. The individual test questions used in the two are indistinguishable.

In general, criterion-referenced test are best to assist in categorical pass-fail decisions with respect to separate specific terms or competencies.

The norm-referenced form is useful in measuring a person's general level of knowledge or understanding of a subject. While categorical decisions are sometimes made on the basis of scores on norm-referenced tests, as in the case of certification examination.

Proponents of criterion-referenced tests have performed a valuable service in emphasizing the importance of clearly defining test goods.

Proponents of criterion-referenced tests sometimes criticize standardized test (norm-referenced) for their leave of specific relevance to what is being taught in a particular unit of study in a given local school system.

The norm-referenced from is useful in measuring a person's general level of knowledge or understanding of a subject.

EXERCISES

1. Why do we need tools of research? Enumerate the various types of research tools used in educational research.
2. "Questionnaire is most frequently or commonly used research tool but misused in the field of education." Comment on this statement.
3. Describe the various steps which are used in designing a questionnaire. Indicate its advantages and limitations.
4. What do you understand by standardized tool of research? Differentiate between criterion-referenced tests and norm-referenced tests.
5. Differentiate between questionnaire and schedule. Indicate problems in which these tools are required.
6. Define the "Rating Scales." Enumerate types of rating scale. Describe the steps for developing Likert type rating scale.

Chapter 14

Collection of Data

Research tools are administered on the sample subjects for collecting evidences or data. Most educational research will lead to the gathering of data by means of some standardized test or self-constructed research tools. It should provide objective data for interpretation of results achieved in the study. The data may be obtained by administering questionnaires, testing, personal observations, interviews and many other techniques of collecting quantitative and qualitative evidence.

The researcher must know how much and what kind of data collection will take place and when. He must also be sure that the types of data obtainable from the selected instruments will be usable in whatever statistical model he will latter use to bring out the significance of the study. The data collection is the accumulation of specific evidence that will enable the researcher to properly analyse the results of all activities by his research design and procedures. The main purpose of data collection is to verify the research hypotheses.

NEED FOR DATA COLLECTION

The data are needed in a research work to serve the following purposes:

1. Collection of data is very essential in any educational research to provide a solid foundation for it.
2. It is something like the raw material that is used in the production of data. Quality of data determines the quality of research.
3. It provides a definite direction and definite answer to a research inquiry. Whatever inquiry has to give a definite answer to an investigation. Data are very essential for a scientific research.
4. The data are needed to substantiate the various arguments in research findings.
5. The main purpose of data collection is to verify the hypotheses.
6. Statistical data are used in two basic problems of any investigation:
   (*a*) Estimation of population parameters, which helps in drawing generalization.
   (*b*) The hypotheses of any investigation are tested by data collection procedure.
7. The qualitative data are used to find out the facts and quantitative data are employed to formulate new theory or principles.
8. Data are also employed to ascertain the effectiveness of new device for its practical utility.
9. Data are necessary to provide the solution of the problem.

MEANING OF DATA

Data means observations or evidences. The scientific educational researches require the data by means

of some standardized research tools or self-designed instrument. Data are both qualitative and quantitative in nature.

Score is the numerical description of an individual with regard to some characteristics or variables. Measurement process is employed to quantify a variable. Data are collected for both variables as well as attributes. These are gathered in terms of frequency and scores. It depends on the type of instrument employed for its measurement. Generally tests yield the data in the form of scores and questionnaires provide the data in the form of frequency. Data are things with which we think of.

Data and facts are used in educational research, therefore, it is essential to understand them clearly.

DIFFERENCE BETWEEN FACTS AND DATA

The facts and data have been distinguished in the following manner:

1. The facts are organized in their original form whereas data are organized in systematic order.
2. The facts do not have any coherence of system whereas data have an organic unity like body.
3. The facts are difficult to interpret. The interpretation of facts is usually subjective and employs the imagination of the researcher. Data can be interpreted easily and most objectively.
4. The facts are mysterious in nature we have to explore the facts but data have no mystery at all.
5. The facts are descriptive in nature whereas data are explanatory.
6. The facts are not amenable to objective statistical treatments whereas data can be easily subjected to in objective statistical treatment.
7. The facts may not be directly the basis of findings or research conclusions, but data are directly linked with research conclusions.
8. The facts are usually too broad and are not linked and a purposive way whereas data are always collected with a sense of purpose.
9. The facts are collected in historical or survey research whereas data are gathered in a scientific and experimental research.

NATURE OF DATA

The research studies in behavioural science or mainly concerned with the characteristics or traits. Thus, tools are administered to quantify these characteristics, but all traits or characteristics can not be Quantified.

The data can be classified into two broad categories:

1. Qualitative data or attributes.
2. Quantitative data or variables.

1. Quantitative Data or Attributes: The characteristics or traits for which numerical value can not be assigned, are called attributes, e.g. motivation, confidence, honesty integrity etc.

2. Quantitative Data or Variables: The characteristics or traits for which numerical value can be assigned, are called variables, e.g. Achievement Intelligena, Aptitude Height, Weight etc.

The distinction is based on the process of measurement rather than on the properties inherent in the phenomenon or trait, for generally properties considered qualitative can be made quantitative by measuring them with an instrument designed to assign numerical values to the various degrees to which they exist.

The decision to research a given phenomenon on the basis of its attributes or on the basis of its quantitative aspects is frequently a matter of choice, depending on such considerations as the need of precision and the ease of manipulation of data.

In fact, the quantification of phenomenon is generally considered essential to the progress of a science particularly at the more advanced levels. Quantification provides a greater refinement and possesses definite advantages by virtue of its statistical treatment.

The quantitative data provide the nature of the characteristic or trait. They have the verbal exposition of the trait. There is much scope for logical manipulation is the interpretation of result. The trait is not quantifiable.

The qualitative data provide the extent and nature of the distribution of the trait or variable measured. The tools are available to measure the variable. In the experimental research data are collected in the controlled situation to study the functional relationship of variables.

Quantification is the process of assigning numerical values to the trait of the subjects of sample which normally would be quantitative. This can be done by :

(*a*) Observations or information by first hand experience. It is used in small children and animals.

(*b*) Systematic collection and analysis of factual data. This is done in historical research.

(*c*) Scales and inventories are designed to explore or reveal the interests, attitude and personality. It is used in the case of study and survey research.

(*d*) Questionnaire, interview and opinionnaire are designed to gain information. This is employed in survey research.

(*e*) Educational and psychological tools are administered to quantify the variables more accurately. These tools are used in scientific research studies.

Various types of research tools are employed to collect the data. These tools yield different types of data.

CONSTANTS

A constant is all characteristic or condition that is the same for all the observed units or sample subjects of a study.

A variable, on the other hand is a characteristic which takes on different values for different sample subjects or for all the observed units.

The use of variable and constant has been illustrated with the help of the following example. Suppose a study is conducted for determing the effect of three different teaching methods upon the achievement in secondary mathematics. Each of three ninth grade maths sections in the same school, are taught by the same teacher, is taught using one of the methods. Both boys and girls are included in each method.

In this study grade level, school and teacher are recognized as constants. It assumes that the teacher can hold constant teaching effectiveness except for the method. The independent variable in the study is the teaching method and achievement in maths is known as the dependent variable or criterion variable.

A dependent variable is the consequent of the independent variable. The functional relationship is analysed between the two variables. The precision of the data is governed by the constants, if these conditions remain unchanged during experimentation. A researcher should be careful or conscious enough about the constants of his investigation.

VARIABLES

The variables are those which vary from person to person and can be quantified by employing measuring instrument. The sample or group variation can be ascertained in terms of numerical values. The characteristic or the trait in the behavioural science which can be quantified is termed as variable.

Variables can be classified into two categories:

1. Continuous variables.
2. Discrete variables.

1. Continuous variables are those for which fractional value exists and have meaning e.g. age, weight, achievement, where 14.5 years, 62.75 kgs and 45.50 scores or any other fractional of a whole unit is logical and measurable within the precision of the instrument used.
2. Discrete variables are those on the other hand, which exist only in units not the fractional value (usually units of one) e.g. 30 boys, 25 girls, 40 Indians and 24 Americans.

This distinction is somewhat more complicated in practice. The typical problem in educational research deals with test scores. These are generally reported as discrete variable though they are often fundamentally continuous. Intelligence is recorded in terms of I.Q.s. as discrete thought by their very computation they are technically continuous.

In research, where the concern is with group measures which almost invariably are fractional, continuous variables appear somewhat more acceptable than discrete variables.

The variables can be classified with regard to their roles or functions In particular study. The assumptions of an investigation determine the role of the variables. The following are the types of variables: independent, dependent or criterion, experimental, control, moderator and intervening variables. When the investigator is concerned with the teachers attitude toward teaching in relation to their classroom verbal interaction. The teaching attitude is the independent variable. In another study the investigator intends to analyse the relationship between classroom interaction and student's achievement. The classroom interaction is the independent variable (whereas in earlier study it is dependent variable) and student's achievement is the dependent variable. Thus, this type of classification is important from a particular research point of view. Every research worker must understand his variables and their roles in his investigation.

VARIATE

The variable is quantified by using an instrument. The quantified variable is termed as variate. When sample subjects I.Q.s or scores of achievement are collected, it is known as variate. The statistical analysis involves variate analysis: uni-variate, bi-variate, multi-variate analysis. It is evident that data collection means to convert variables into variates so that data can be subjected to an appropriate statistical analysis for obtaining the results.

QUANTIFICATION OF VARIABLE

Quantification is the process of assigning numeral value to the extend or amount of a variable of an individual. The quantification is done by employing the process of measurement. This process yields data and scores.

Many studies in education produce data for the verification of research hypotheses so as to draw conclusions. Some other studies in education produce evidences that require evaluation by subjective methods which do not readily permit the use of statistical analysis are termed as qualitative data. These qualitative data may be converted first into their quantitative data. The statistical techniques may be applied to test the significance of data. If qualitative data cannot be converted into quantitative data, a descriptive interpretation is done.

CHARACTERISTICS OF QUANTITATIVE DATA

The quantitative data are collected by administering the research tools. These should possess the following characteristics:

1. The quantitative data should be collected through standardized tests. If self-made test is used it should be reliable and valid.
2. They are highly reliable and valid. Therefore, generalization and conclusions can be made easily with certain level of accuracy.
3. The obtained results through quantitative data can be easily interpreted with scientific accuracy. The level of significance can also be determined.
4. The scoring system of quantitative data is highly objective.
5. The use of quantitative data is always based upon the purpose of the study. The specific psychometric tests are used in difficult investigation.
6. The inferential statistical can be used with the help of quantitative data.
7. The precision and accuracy of the results can be obtained by using quantitative data in an educational research.

TYPES OF DATA

There are four basic ways of quantifying the variables. They are also called levels of measurement or scales of measurement. These are commonly referred to as:

1. Nominal scale,
2. Ordinal or rank scale,
3. Equal-interval scale, and
4. Ratio scale.

1. Nominal Scale

The nominal scale is the least precise or crude of the four basic scales of measurement. It simply implies the classification of an item into two or more categories without any extent or magnitude. There is no particular order assigned to them. The frequency or numbers are used to give a name to something that may be used for determining per cent, mode. For example boys and girls; pass and fail; rural and urban.

In classroom observation the measurement is done at nominal scale. The teaching and instruction are organized considering the mode of the students, because teacher cannot pace with each and every student in his teaching and learning process.

2. Ordinal Scale

The ordinal scale is more precise scale than the nominal scale. It allows the teacher to assign values by placing of arranging the observations in relative rank order. No value is assigned to the distances to the positions of ranking. This scale assigns observations to categories by number and arranges them in some logical order. It does not require the relationship of equivalence but also requires one observation to be greater or lesser than the other.

This scale is used frequently in the schools for prize distribution and to provide the motivation by the technique of competition. In asking the questions teacher considers the place of students in the class.

3. Equal Interval Scale

The equal interval scale is more precise and refined scale than nominal and ordinal scales. This scale has all the characteristics and relationship of the ordinal scale, besides which distances between any two numbers on the scale are known. The zero point and the unit of measurement used on the scale are arbitrary assumed. A linear relationship is established in the equal-interval scale.

The equal-interval scale has the greater use in teaching-learning situation, educational administration, educational guidance and counselling and educational research. The effectiveness of any instructional procedure, can be evaluated precisely by collecting the data on this scale. The measurement in education is usually done on equal interval scale. The dependable inferences are drawn in educational research by collecting evidences on equal interval scale.

These three types of data are mainly used in behavioural researches. These have been illustrated in the following table:

Subject	*Nominal* *Sex*	*Ordinal* *Achievement in ranks*	*Equal-interval* *Achievement in scores*
A	Boy	3rd	64
B	Girl	1st	76
C	Girl	2nd	68
D	Boy	5th	58
E	Girl	4th	60

These scales have not absolute ‘zero’. The group performance is the reference point.

4. Ratio Scale

Ratio scale has the properties of equal-interval scale plus two additional characteristics:

(*a*) This scale has a true, rather than arbitrary ‘zero’. It is possible to indicate the complete absence of property. The zero point on a centimeter scale indicates the absence of height. However, the zero point on a Fahrenheit temperature scale does not indicate the absence of temperature; this is a scale with zero defined arbitrarily.

(*b*) The ratio scale numerals have the qualities of real numbers, and can be added, subtracted, multiplied; or divided. A may be so many units greater than B and may also be so many times

as great as B. Fifteen grams is three times five grams and fifteen grams is ten more than five grams.

Proceeding from nominal to ratio scale in order each type makes possible more information about the property described. If the variable permit its application, the type of scale provide the maximum amount of information should be used.

DATA COLLECTION

In the behavioural science data are collected by administering various types of research tools of the human sample subjects. The different traits and characteristics are quantified by using measurable instruments. These research tools provide different types of data. It is very essential for a research worker to understand the trait, tools and type of data. This has been illustrated with the help of the following table:

No.	*Level*	*Properties*		*Assumptions*	*Examples*	*Statistics*
1.	Nomina l Scale	Classification Equate Non-equate	(1)	All members of a set are assigned the same numeral, and no two sets are assigned the same numeral.	Car registration plate numbers Simple questionnaire and interviews data gathered on an all or none basis	Mode Coefficient of association
2.	Ordinal Scale	Classification Order Equate Non-equate	(1) (2)	As above Objects can be rank ordered on the basis of an operationally defined characteristic or property	Moh's scale of hardness Most psychological and educational test scores.	Mode Median Percentiles Coefficient of association Ranking coefficient
3.	Interval Scale	Classification Order equal Units Equate Non-equate Add subtract Multiply divide	(1) (2) (3)	As above As above Distances on the scale represent equal intervals	Temperature scales Very well validated intelligence tests, etc.	Mode Median Mean Percentile Range Standard Deviation Average deviation
4.	Ratio Scale	Classification Order Equal Units Absolute Zero Equate Non-equate Add subtract Multiply divide	(1) (2) (3) (4)	As above As above As above Scale has an absolute or natural Zero	Common, scales of length, Mass and time Some scale of loudness	Standard score Coefficient of association Ranking Coefficient Simple partial and multiple correlation.

A Classification of Scales of Measurement and Common Statistics

Types of Data With Reference to the Traits

Trait	*Tool*	*Type of Data*
1. Intelligence	Psychological tests	Equal-interval scale
2. Achievement	Educational tests	”
3. Aptitude	Psychological tests	”
4. Attitude	Scales	Ordinal scale
5. Interest	Inventories	Equal interval scale
6. Personality	”	”
7. Adjustment	”	”
8. Opinions of feelings	Questionnaire or Opinionnaire	Nominal scale

There are other types of research tools which are used to collect' the data. For example, 'observation technique' is most frequently used to collect the data which yields the data at nominal scale and also at equal-interval scale.

In the following table research tools have been classified with regard to scale for measurement and types of statistics may be employed of analysis purpose.

Classification of Tools and Research with Regard to the Level of Measurement

Scale	*Tools of Research*	*Statistics*
1. Nominal Scale	Questionnaire Interview Schedule Observation	Model, frequency percentage Simple statistics X_2-Test and 'C'
2. Ordinal scale	Scale observation Rank scale	Median, Spearman's rank correlation X^2 test Median test etc.
3. Equal-interval scale	Psychological and educational tests Observation scale	Mean, Sd. Pearson's correlation 't' test and 'f' test etc.
4. Ratio scale	Physical measurement	Arithmetic mean Pearson's correlation Mathematics is used.

The types of data depend on nature of research tool employed for this purpose. Statistical techniques are virtually selected by considering the nature of research tool and data collected at nominal, ordinal or equal interval scales. It is not the statistical technique but type data which determine the fate of research project.

Ethical considerations in Collection of Data

Any researcher who involves human sample subjects in his research has certain responsibilities towards them. Since the activities of the sample subjects are often closely associated with data collection process, it is appropriate to consider ethical considerations here.

The following points have to be considered in process of data collection:

1. The researcher must protect the dignity and welfare of human sample subjects.
2. The human sample subjects freedom to decline participation must be respected, and the confidentially of research data must be maintained.
3. The researcher must guard against violation or invasion of privacy.
4. The responsibility for maintaining ethical standard remains with the individual researcher and the principal investigator or supervisor is also responsible for actions of his scholars.

Any researcher anticipating "the use of human sample subjects should consult on 'ethics' statements such as those mentioned above. A researcher should not mention the name of subjects anywhere in the report. If possible name of institutions where sample subjects have selected for data collection should not be mentioned even in the appendix. The code number should be used for this purpose. As a general rule, he must respect the human sample subjects selected in his specific research study.

Precautions in Data Collection

In the data collection the following precautions should be observed:

1. The data must be relevant to the research problem.
2. It should be collected through formal or standardized research tools.
3. The data should be such as these can be subjected to statistical treatment easily.
4. The data should have minimum measurement error.
5. The data must be tenable for the verification of the hypotheses.
6. The data should be such as parameters of the population may be estimated for inferential purpose.
7. The data should be complete in itself and also comprehensive in nature.
8. The data should be collected through objective procedure.
9. The data should be accurate and precise.
10. The data should be reliable and valid.
11. The data should be such that these can be presented and interpreted easily.
12. The scoring procedure of the research tool should be easy and objective.

ORGANIZATION OF DATA

After the data have been collected. it must be organized and analyzed to draw proper inferences.

The mass of data collected through the use of various tools, however reliable, valid and adequate it may be is yet but raw. It needs to be systematized and organized i.e. edited classified and tabulated. before it can serve any worthwhile purpose. Editing implies the checking of gathered data for accuracy, utility and completeness. Classifying refers to the dividing of the information into different categories classes or heads, for the use. Tabulating denotes the recording of the classified material in accurate mathematical terms e.g. marking and counting frequency tallies for different items on which Information is gathered. Tabulation is a tedious and painstaking process and must be accurate. Before, tabulating all raw data should be tested on the basis of the purpose for which they are gathered and only the useful and usable data should be tabulated. Tabulating machines and other mechanical aids for tabulating are becoming current.

Once the data have been collected through the use of the measuring instruments, some type of tabulation and possibly a transformation of data in preparation for the analysis may be necessary. if answer sheets are to be hand scored routine precautions should be taken to practice for scores and accuracy checks while the actual scoring is being done.

Research study which includes the collection of considerable data using standardized tests should make provision for machine scoring.

There are IBM answer sheets with space of responses upto 150 items. Test scoring machines provide for obtaining the actual scores, they commonly provide tabulations, summaries, and conversions to various types of standard score. If some cases the machines are connected to a computer to provide certain kinds of analysis.

Machine scoring of tests is usually less expensive than hand scoring. Other advantages of machine scoring are its accuracy and its preparation of the data for computer analysis if necessary. Not all educational "research data are collected in a form that can be machine is not to be used to transmit data from the answer sheet to the computer is an important part of the research procedure.

The data should be so organized that minimum effort is required to transmit the data from its original form to the IBM card. The format data card, indicating the information that enters into each column, must be defined by the researcher. Information is commonly of two types: identification and responses of the subject. Any confusion should be eliminated to minimize the number of copy errors. The computations on the calculator should be so performed in such a manner that several internal checks can be made during the calculation.

EXERCISES

1. Define the term 'Data', How it is different from 'facts' and 'scores'?
2. Indicate the need for data collection and describe the nature of data.
3. (*a*) Differentiate between questionnaire data and quantitative data,
   (*b*) Distinguish among attribute, variable, constant and variate.
4. Enumerate the types of data and describe these types in detail with reference to tools, types of research and statistical techniques,
5. Indicate the ethical consideration in data collection and their justification in conducting a research.
6. What precautions are to be taken in collection of data? Indicate the limitations in data collection.
7. What do you understand by the term 'Organisation of data'? Indicate the need and importance of data organization in conducting educational research.

Chapter 15

Analysis of Data

A prime responsibility of the educational researcher is that of being able to make either a probability or logical inference covering the tenability of his testable hypothesis. The acceptance or rejection of these hypotheses will ultimately determine what contribution the study makes to the scientific' development of a particular area. This is especially tried in the analysis for interpretation of data.

The analysis and interpretation of data represent the application of deductive and inductive logic to the research process. The data are often classified by division into, subgroups, and are then analyzed and synthesized in such a way that hypothesis may be verified or rejected. The final result may be a new principle or generalization. Data are examined in terms of comparison between the more homogeneous segments within the group any by comparison with some outside criteria.

Analysis of data includes comparison of the outcomes of the various treatments upon the several groups and the making of a decision as to the achievement of the goals of research. Data relevant to each hypothesis must be assembled in quantitative form and tested to determine whether or not there is a significant difference in the results obtained from the controlled groups. Usually the analysis develops as a comparison between groups however, sometimes the type of data obtainable tends itself better to the existing differences by contrast or by summing up.

It is virtually impossible to complete a scientific analysis without using some form of statistical processing. This may involve depicting differences by complicated inferential statistics such as the analysis of variance, and analysis of covariance technique.

Each statistical method is based upon its own or specific assumptions regarding the sample, population and research conditions. Unless these factors are considered in advance the researcher may find that it is impossible to make valid comparison for purpose of inferences.

NEED FOR ANALYSIS OF DATA OR TREATMENT OF DATA

After administering and scoring research tools scripts, data collected and organized. The collected data are known as 'raw data.' The raw data are meaningless unless certain statistical treatment is given to them. Analysis of data means to make the raw data meaningful or to draw some results from the data after the proper treatment. The 'null hypotheses' are tested with the help of analysis data so to obtain some significant results. Thus, the analysis of data serves the following main functions:

1. To make the raw data meaningful,
2. To test null hypothesis,
3. To obtain the significant results,
4. To draw some inferences or make generalization, and
5. To estimate parameters.

There are two approaches which are employed in analysis of data: Parametric analysis of data and non-parametric analysis of data. The details of these approaches have been discussed in this chapter.

SELECTING THE LEVEL OF DATA

If we are working with variables which do have a quantitative aspect we can use the data collecting process of measurement. In this process we attempt to achieve some quantitative estimate of the variable or, more realistically of the amount of the variable which each of our research subject has. We can aspire to four different levels of measurement – Nominal, Ordinal, Interval and Ratio–and these are listed from the weakest level (nominal) to the strongest level (ratio).

Here is seldom any question In labelling nominal data for nonquantitative data are typically obvious to researcher and reader alike. However, for quantitative data, the distinction between ordinal and interval or ratio data is a critical one and moreover, one which different researchers see differently. Some research specialists or guides advise as a general principle in planning data analysis that the researcher considers the data ordinal, unless he can specifically identify a rationale other than the assignment of consecutive digits to consider them interval data. This rationale may be purely intellectual and based on the processes involved in selecting the various points one scale, or the rationale may be empirical and based on the data collected during pilot work from which the final instrument was derived. But there should be some specific set of reasons or data which can be cited when the researcher departs from treating his numerical data as ordinal data.

ANALYSIS OF DATA

Analysis of data means studying the tabulated material in order to determine inherent facts or meanings. It involves breaking down existing complex factors into simpler parts and putting the parts together in new arrangements for the purpose of interpretation.

A plan of analysis can and should be prepared in advance before the actual collection of material. A preliminary analysis on the skeleton plan should as the investigation proceeds, develop into a complete final analysis enlarged and reworked as and when necessary. This process requires an alert, flexible and open mind. Caution is necessary at every step. In case where a plan of analysis has not been made beforehand. Good. Barr and Scates suggest four helpful modes to get started on analysing the gathered data:

(*i*) To think in terms of significant tables that the data permit.

(*ii*) To examine carefully the statement of the problem and the earlier analysis and to study the original records of the data.

(*iii*) To get away from the data and to think about the problem in layman's terms.

(*iv*) To attack the data by making various simple statistical calculations.

In the general process of analysis of research data, statistical method has contributed a great deal. Simple statistical calculation finds a place in almost any research study dealing with large or even small groups of individuals, while complex statistical computations form the basis of many types of research. It may not be out of place, therefore to enumerate some statistical methods of analysis used in educational research.

STATISTICAL ANALYSIS OF DATA

Statistics is the body of mathematical techniques or processes for gathering, describing orgainising and interpreting numerical data. Since research often yields such quantitative data, statistics is a basic tool of measurement and research. The research worker who uses statistics is concerned with more than the manipulation of data, statistical methods goes back to fundamental purposes of analysis. Research in education may deal with two types of statistical data application.

1. Descriptive Statistical Analysis, and
2. Inferential Statistical Analysis.

1. Descriptive Statistical Analysis

Descriptive statistical analysis is concerned with numerical description of a particular group observed and any similarity to those outside the group can not be taken for granted. The data describe one group and that one group only.

Much simple educational research involves descriptive statistics and provides valuable information about the nature of a particular group or class.

2. Inferential Statistical Analysis

Inferential statistical analysis involves the process of sampling, the selection for study of a small group that is assumed to be related to the large group from which it is drawn. The small group is known as the sample; the large group, the population or universe, A statistics is a measure based on a sample. A statistic computed from a sample may be used to estimate a parameter, the corresponding value in the population which it is selected.

DESCRIPTIVE DATA ANALYSIS

Data collected from tests and experiments often have little meaning or significance until they have been classified or rearranged in a systematic way. This procedure leads to the organisation of materials into few heads.

(*i*) Determination of range of the interval between the largest and smallest scores.

(*ii*) Decision as to the number and size of the group to be used in classification. Class interval is therefore, helpful for grouping the data in suitable units and the number and size of these class intervals will depend upon the range of scores and the kinds of measures with which one is dealing. The number of class intervals which a given range will yield can be determined approximately by dividing the range by the interval tentatively chosen.

Most commonly used methods of analysis data statistically are:

1. Calculating frequency distribution usually in percentages of items under study.
2. Testing data for normality of distribution skewness and kurtosis.
3. Calculating percentiles and percentile ranks.
4. Calculating measures of central tendency-mean, median and mode and establishing norms.
5. Calculating measures of dispersion-standard deviation mean deviation, quartile deviation and range.
6. Calculating measures of relationship-coefficient of correlation, Reliability and validity by the Rank-difference and Product moment methods.

7. Graphical presentation of data-Frequency polygon curve, Histogram, Cumulative frequency polygon and Ogive etc.

While analyzing their data investigations usually make use of as many of the above simple statistical devices as necessary for the purpose of their study.

INFERENTIAL DATA ANALYSIS

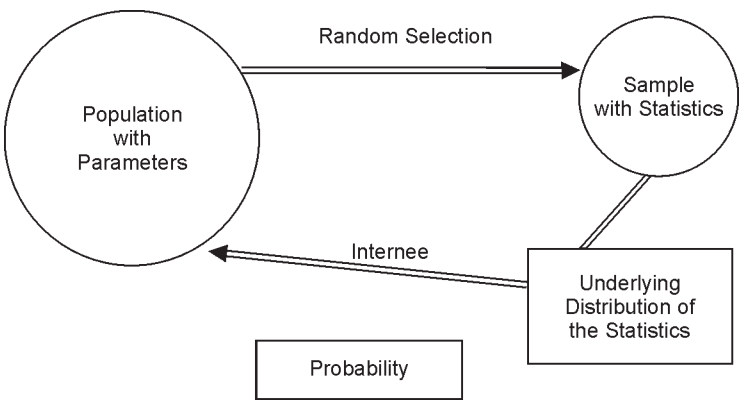
The primary purpose of research is to discover principles' that have universal application. But to study a whole population in order to arrive at generalization would be impracticable if not impossible.

A measured value based upon sample data is statistic. A population value estimated from a statistic is a parameter. A sample is a small proportion of a population selected for analysis. By observing the sample, certain inferences may be made about the population. Samples are not selected haphazardly, but are chosen in a deliberate way so that the influence of chance or probability can be estimated. Several types of sampling procedures are described each one is particularly appropriate in a given set of circumstances.

INFERENCE FROM STATISTICS TO PARAMETERS

The basic ideas of inference are to estimate the parameters with the help of sample statistics which play an extremely important role in educational research. These basic ideals of which the concept of underlying distribution is a part, comprise the foundation for testing hypotheses using statistical techniques.

The chain of reasoning from statistics to parameters is a part of what we call inferential statistics. The inference is from the statistics to the parameters. This chain of reasoning has been illustrated with help of the following diagram:



(*a*) We have a population and want to make decisions about measures of the population namely parameters.

(*b*) We have a random sample and compute measures of the sample which are termed as statistics.

(*c*) The statistics are used to estimate parameters with sample fluctuation.

(*d*) We have to obtain the sample statistics which are the facts that we have to infer back to the parameters in the light of the underlying distribution and probability.

We have a population and we want to know something about the descriptive measures of this population, namely the parameters. It is desirable or impossible to measure the entire population, so a random sample is selected from the population. The descriptive measures of the sample are known as statistics and the statistics can be determined. Since the sample is a random sample, we know that the statistics can be employed to estimate the population parameters within fluctuation due to sampling. It is at this point that the underlying distribution of the statistics comes in. If we know the underlying distributions we know how the statistics behaves. The appropriate underlying distribution for a specific statistics has been determined for us by mathematical theory and has been tabulated in table form. Underlying distributions are commonly theoretical distributions.

The parameters are never known for certain unless the entire population is measured and then there is no inference. We look at the statistics and their underlying distributions and from them we reason to tenable conclusions about the parameters.

SELECTING THE STATISTICS

As he plans the analysis of the data the researcher should consider two sections of the research report in which statistics will be relevant. The first of these is the section in which the data producing sample is described and in which may also be compared to the selected sample and to the population. In describing the sample, the basic descriptive statistics of the summary frequency distribution and the appropriate measures of central tendency and variability serve to provide the reader with some insight into the nature of the respondents. Researches are interested in the usual demographic characteristics such as gender, age, occupation and educational level, but in addition anyone project will suggest other descriptive variables about which data should be collected.

Provided the data are available, the researcher should also employ inferential statistics such as Chi-square or the t-test to determine whether or not his data producing sample differs from his selected sample or population by selecting which analysis he will prefer at his early stage, the researcher structures the kinds of data he will need to produce about the population and can incorporate the search for these data into his data gathering plan.

The second section of the report in which statistical procedures plays role is in the reporting of research results. The selection of these procedures should be well structured by this point if the researcher has stated specific hypotheses and research questions. The necessity to test the hypothesis provides guidance to statistical procedures at the general level, with the decision as to the level of data available providing the key to which specific procedures are to employ. Thus, hypothesis which refers to the expected a relationship between two variables, immediately indicates the need for a correctional analysis. Once the researcher decides that the two variables will yield ordinal data, for example, he can move directly to the specification of the rank order correlation.

The specification of statistical analysis at this stage of the research also enables the researcher to estimate his data analysis cost in both time and money and make whatever arrangements are necessary to reserve time on data-processing facilities.

The elementary and special statistical techniques of analsysis are as follows:

Elementary Statistical Techniques of Analysis

Most commonly used statistical techniques of analysis data are:

1. Calculating frequency of distribution in percentages of items under study.
2. Testing data for normality of distribution Skewness Kurtosis and mode.
3. Calculating percentiles and percentile ranks.
4. Calculating measures of central tendency-Mean, Median and Mode and establishing Norms.
5. Calculating measures of dispersion-Standard deviation, Mean deviation, quartile deviation and range.
6. Calculating measures of relationship-Coefficients of Correlation, Reliability by the Rank difference and Product moment method.
7. Graphical presentation of data-Frequency polygon curve, Histogram, Cumulative frequency polygon and Ogive, etc.

While analysis their data investigator usually makes use of as many of the above simple statistical devices as necessary for the purpose for their study. There are some other complicated devices of statistical analysis listed below which researcher use in particular experimental or complex casual-comparative studies and investigations.

Special Statistical Techniques of Analysis

The following are the special statistical techniques of analysis:

1. Test of students '*t*' and analysis of variance for testing significance of differences between statistics especially between Means.
2. Chi-square test for testing null hypothesis.
3. Calculation of Biserial '*r*' and Tetrachoric '*r*' for finding out relationship between different phenomena in complex situations.
4. Calculation of partial and multiple correlation and of Bivariate and Multivariate Regression Equations for findings out casual relationship between various phenomena involved in a situation.
5. Factorial Analysis for the purpose of analysing the composition of certain complex phenomena.
6. Analysis of co-variance for estimating the true effect of the treatment after adjusting the initial effect.

PLANNING FOR DATA ANALYSIS

The next aspect of the data analysis plan is to scan the data gathering instruments in the context of data analysis. During the process of selecting a method and technique and developing an instrument, the researcher is usually so oriented to content and procedure that he ignores the relatively minor issues in instrument development, such as whether or not their is a place for the respondent to indicate his name, age, class, or any other data that will be required for data analysis. After the data are collected and about to be analyzed it is often too late to capture this information. Thus, it is at this point of planning the data analysis that the researcher can profitability refer to the list below of characteristics of the data gathering instrument that will expedite data analysis.

1. There should be a place for name, school, class, age, sex or any other classifying information the researcher will need in data analysis.

2. Every item should be numbered, and every option within an item should be separately numbered or lettered, for case of data analysis.
3. Options should not overlap on structured questions, that is, if one option is 5-10, the next should begin with 11.
4. It is preferable to have options circled rather than checked. This expedites the analysis of data and also eliminates the possibility that the check below means 'high school' to some respondents rather than 'College' as the researcher intended.
5. The order in which items appear on an instrument reflect the priority of information sought. The researcher must recognize that respondents and observers tire and if they do the items which appear late in the instrument are answered less carefully or omitted entirely.

The order of the items has been planned with the processing of data in mind. If two pieces of data are to be analyzed simultaneously, this analysis can be expedited considerably if they are physically close together on the instrument. If some sub-analysis within the instrument is planned, such as computing the number of items correct on a sub-test or the number of positive responses on an interest inventory, the layout of the instrument should consider the placement of those items on each sub-test.

The instrument should provide the respondent with a way of indicating inability or unwillingness to answer a question, record an observation, or respond to a measure.

The possibility of pre-coding instruments, or printing them on different colour paper as an aid to data analysis should be considered. Instrument used in the pre-and-post administration of any technique should be easily distinguishable and so impossible to confuse.

CONSIDERATIONS FOR STATISTICAL ANALYSIS

There are various statistical techniques for analysing data. To choose an appropriate technique of statistical analysis in the challenging task to a research worker. It has two main functions:

1. Interpretation of results, and
2. Presentation of data.

The major types of tests are employed for analysing data so as to interpret the results. There are:

(A) Parametric statistics or tests, and

(B) Non-parametric statistics or tests.

A researcher has to select either of these approaches for analysing his own research data. The following are the criteria for choosing an appropriate statistical approach.

(A) Considerations for Parametric Statistics

This type of statistical analysis may be employed effectively in the following conditions:

1. Probability or representative sample has been employed in the investigation.
2. Variables of the study can be qualified at interval scale.
3. Specific assumptions are fulfilled. The obtained data are normally distributed or not free distribution.
4. The population of the study has been clearly defined.
5. Objectives of the research study.

Under this approach the following statistical techniques are employed :

(*a*) To study the descriptive relationship of two or more variables:

a_1 – Pearson's product moment method of correlation (two variables)

a_2 – Multiple correlation (more than two variables)

a_3 – Partial correlation (more than two variables)

a_4 – Factor analysis-extracting factors or estimating psychological or factorial validity of tests.

(*b*) To analyse the functional relationship of the variables:

b_1 – Main effect of two treatments '*t*' test

b_2 – Main effect of more than two treatments *F*-test

b_3 – Interaction effect of two or more variables-Two or more ways analysis variance techniques

b_4 – Gain or loss of more than two treatments-Analysis of covariance and correlated '*t*' test.

(B) Considerations for Non-parameteric Statistics

This type of statistical analysis may be used effectively in the following situations:

1. When non-probability sample is selected in the research study.
2. The variables of the study are quantified at any level of measurement, mainly, nominal and ordinal scale. It may be in the discrete form.
3. No assumption is required for this approach.
4. Free distribution of data, may be skewed or may be normally distributed.
5. Objectives of the study.

In this approach the following statistical techniques are generally used :

(*a*) To study the relationship of two or more variables:

a_1 – Spearman Rho correlation in small sample not in large sample for two variables. Data are available at ordinal or internal scale.

a_2 – x^2 and contingency correlation. It is used when two or more variables are taken. The data may be nominal or ordinal scale or interval scale.

a_3 – Analysis variance.

(*b*) To analyse the difference between two or more groups:

b_1 – Median test for small test.

b_2 – x^2 test for large sample also for small sample.

b_3 – Run test and *U*-test when data are on ordinal scale.

b_4 – Sign test.

BASIS FOR SELECTING A STATISTICAL TECHNIQUES

The main basis for selecting an appropriate statistical test is the nature of data and number of variables included in the investigation. In the behavioural science researches: nominal, ordinal and interval types of data are commonly used. The table provides the basis for selecting a statistical test apart from the above considerations.

Commonly used Measures of Association for Different Types of Variables

Measure of Association to Use	*Nature of Variables Involved*	*Restrictions, Assumptions, or Comments*
Pearson product- moment correlation.	2 continuous variables	Linear relationship interval or ratio scales
Rank-order correlation or Kendall's tau	2 continuous variables	Ordinal scales
Tetrachoric correlation	2 continuous variables both of which have been dichotomized	Normal bivariate distribution of the two variables
Correlation ration (Eta coefficient)	1 continuous variable 1 variable, either continuous or a discrete set of categories	Non-linear relationship
Intraclass correlation	1 continuous variable 1 variable, a discreate set of categories	Intent is to ascertain degree of similarity within groups interval or ratio scale
Biserial correlation	1 continuous variable 1 continuous variable which has been dichotomized	Interval or ratio scale
Point biserial correlation	1 continuous variable 1 true dichotomy	Interval or ratio scale
Fourfold point correlation (phi-coefficient)	2 true dichotomies	Nominal or ordinal scale
contingency coefficient	2 sets of unordered categories	Nominal scale
Mahalanobis D2 (from linear discriminant function) or multiple biserial correlation	1 set of unordered categories 1 or more variable of any sort	Intent is to determine degree of similarity among the group on basis of several measures
Partial correlation	3 or more continuous variable	Intent is to find to degree of relationship between any two with the effects of the others held constant
Multiple correlation (from multiple regression)	3 or more continuous variables	Intent is to determine predictability of one variable on basis of several others linear relationships
Kendall’s coefficient or concordance	3 or more continuous variables	Intent is to determine the overall amount of agreement ordinal scale
Intraclass correlation	3 or more continuous variables	Estimates average of inter-correlation between pairs.

PRESENTATION OF DATA

The presentation of data is an important aspect of analysing of data. The purpose of presentation of data is to highlight the results and to make data or results more illustrative. The visual presentation of data or results is simple and easy to understand. The graphical and pictorial presentation provide the geometrical image of data. It enables us to comprehend the essential features of the frequency distribution. It also helps in observing the assumptions of the statistical analysis applied for the treatment of data. The presentation of data serves the following functions:

Basic for Selecting a Statistical Test Types and Number of Independent Variables

<table>
<tr><td rowspan="11">DEPENDENT VARIABLES</td><td></td><td></td><td colspan="2">Interval</td><td colspan="2">Ordinal</td><td colspan="2">Nominal</td></tr>
<tr><td></td><td></td><td>1</td><td>More than 1</td><td>1</td><td>More than 1</td><td>1</td><td>More than 1</td></tr>
<tr><td></td><td>0</td><td></td><td>Factor Analysis</td><td colspan="2" rowspan="3">Transformation of Scale</td><td></td><td></td></tr>
<tr><td></td><td>1</td><td>Correlat-ion</td><td>Multiple Correlat-ion</td><td>Analysis of Variance (or t-test)</td><td>Analysis of Variance</td></tr>
<tr><td></td><td>More than 1</td><td>Multiple Correlat-ion</td><td></td><td></td><td></td></tr>
<tr><td></td><td>0</td><td colspan="2" rowspan="3">Transformation of Scale</td><td></td><td>Coefficient of concord-ance (W)</td><td></td><td></td></tr>
<tr><td></td><td>1</td><td>Spearman Correlat-ion Kendall's Tau (τ)</td><td colspan="2">Sign test, median test U-test Kruskal-Wallis</td><td>Friedman's two-way analysis of variance</td></tr>
<tr><td></td><td>More than 1</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>0</td><td></td><td></td><td></td><td></td><td>Chi-square</td></tr>
<tr><td></td><td>1</td><td>Analysis of Variance</td><td></td><td>Sign test, Meidan test U-test Kurskal Wallis</td><td></td><td>Phi-Coeff. (f) Fisher exact test Chi-square</td><td></td></tr>
<tr><td></td><td>More than 1</td><td>Analysis of Variance</td><td></td><td>Friedma's two-way analysis of variance</td><td></td><td></td><td></td></tr>
</table>

1. Visual or pictorial presentation of data
2. Makes the data to comprehend easily
3. Helps in understanding the nature of the distribution of data
4. The assumptions of statistical analysis can also be observed.

Generally the following types graphical presentation are attempted in behavioural researches:

(*a*) Bar diagrams and Histogram
(*b*) Graphical presentation
(*c*) Polygons and curve or Cumulative frequency curve
(*d*) Pie diagrams.

A. Parametric Tests

The parametric tests are the tests of the most powerful type and should be used if their basic assumptions are based upon the nature of the population values and the way that sample have been selected:

1. The observations are independent. The selection of one case is in no way dependent upon the selection of any other case,
2. The population values are normally distributed or, if not, the nature of their distribution is known.
3. The population values have equal variances or the ratio of their variances is known.
4. The variables measured are expressed in interval or ratio scales. Nominal or ordinal do not qualify.

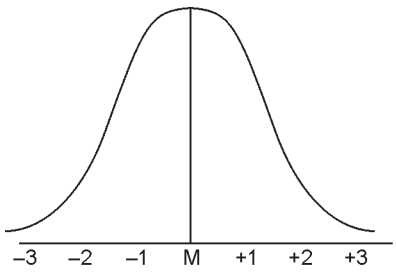


Fig. Normal curve of distribution of Individual scores

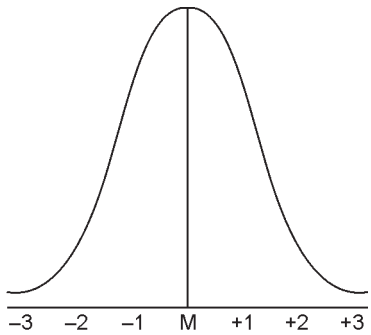


Fig. Normal curve of distribution of sample means

THE CENTRAL LIMIT THEOREM

If a number of equal-sized large samples are selected at random from an infinite population.

1. The means of the samples will be normally distributed.
2. The mean of the sample means will approximate the mean of the population or parameters.

If we selected a number of samples of 100 teachers from the population of teachers in Meerut, the mean ages of the samples, would not be identical. A few would be relatively high, a few relatively low, but most of them would tend to cluster around their own mean. The variation of these sample means is due to what is known as sampling error. The term does not suggest any fault in the sampling process. It merely identifies the chance variations that are inevitable when, a number of randomly selected sample means are computed.

Standard Error of the Mean or SE_{Mn}

The means of randomly selected samples, which are normally distributed, have their own standard deviation known as the standard deviation or standard error of the mean. The standard error of mean of a sample is computed from the formula:

$$SE_{Mn} \quad \text{or} \quad \sigma M = \frac{S}{\sqrt{N}}$$

Where,

Se_{Mn} = Standard error of mean

S = Standard deviation of sample scores

N = Size of the sample

The standard error of sample means has a smaller value than the standard deviation of the individual scores. This is understandable because in computing the means which are middle score values. The following figures illustrate this relationship.

Note the differences between the range and standard deviation of individual scores and those of sample means.

From the formula $SE_M = S/\sqrt{N}$, it is apparent that as the size of the sample increases, the standard error of means decreases. As the sample N approaches infinity the mean approaches the population and the standard error of mean approaches zero.

$$SE_{Mn} = \frac{S}{\sqrt{N}} = 0$$

As N is reduced in size and approaches one, the standard error of the mean approaches the value of the standard deviation of the individual scores.

$$SE_{Mn} = \frac{S}{\sqrt{N}} = \frac{S}{1} = S$$

This analysis suggests that, other factors being equal statistical inferences based upon small samples have larger margins of error than those based upon larger samples.

The value of the true mean of an infinite population is not known, for it cannot be calculated. But a particular mean calculated from a randomly selected sample can be related to the population mean in the following way. Approximately:

68 per cent of sample means will lie within a range of ± one SE_{Mn} of the population mean.

95 per cent of sample means will lie within ± 1.96 SE_{Mn} of the population -mean.

99 per cent of sample means will lie within ± 2.58 SE_{Mn} of the population mean.

The Standard Error of the Difference between Two Sample Means

The standard error of difference between two independent sample means may be calculated by the following formula:

$$SE_{(M_1 - M_2)} = \sqrt{\left(\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}\right)}$$

N_1 = number of cases in first sample
N_2 = number of cases in second sample
S_1 = standard deviation of first sample
S_2 = S.D. of second sample.

CRITICAL RATIO (CR OR Z)

Using this value we may calculate the statistical significance of the differences between an experimental and a control means, if the experimental sample group and the control sample group are randomly selected from the same population. When the size of samples is large (more than 30) we may calculate what is known as the critical ratio, (CR) a ratio of the difference between experimental and control means (numerator), and the standard error of the difference between the two means (denominator).

$$CR = \frac{M_1 - M_2}{\sqrt{\left(\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}\right)}}$$

At this point an example might be helpful. Let us assume that an experiment is set up to compare the effectiveness of two methods of teaching reading. Two groups are randomly selected from the same population, one designated as the experimental group is taught by the initial teaching alphabet approach, while the other is taught by the traditional alphabet method. At the end of the year a standardized reading test is administered and the mean scores for each group are computed. The effectiveness of the experimental group method as compared with the effectiveness of the control group method is the issue, with the end of year mean scores of each group, the basis of comparison.

A mere quantitative superiority of the experimental group mean score over the control group mean score is not conclusive proof of its superiority. Since we know that means drawn from same population are not necessarily identical, any difference could possibly be attributed to sampling error. The difference must be greater than that reasonably attributed to sampling error to be statistically significant.

NULL HYPOTHESIS

A null hypothesis states that there is no significant difference between two or more parameters. It is concerned with a judgement as to whether apparent differences are real differences or whether they merely result from sampling error.

The experimenter formulates a null hypothesis, a no difference hypothesis. What he hypothesizes, is that any apparent difference between the mean achievement of the two sample group at the end of the experiment is simply the result of sampling error, as explained by the central limit theorem.

If the difference between the mean achievement of the experimental group and control group is too great to attribute to the normal fluctuations that result from sampling error, he may refute or reject the null hypothesis, saying, in effect, that it is not true that the apparent difference is merely the result of sampling error. These means no longer behave as two random sample means from the same population. Something has happened to, or affected, the experimental group in such a way that it behaves like a sample from a different or changed population. Thus, the researcher may conclude the experimental

treatment not sampling error accounted for the difference in performance. The experimenter is using a statistical test to discount chance or sampling error as a variable.

If the difference between means was not great enough to reject the null hypothesis, the researcher accepts it. He concludes that there was no significant difference and that the sampling error probably' explained the apparent difference.

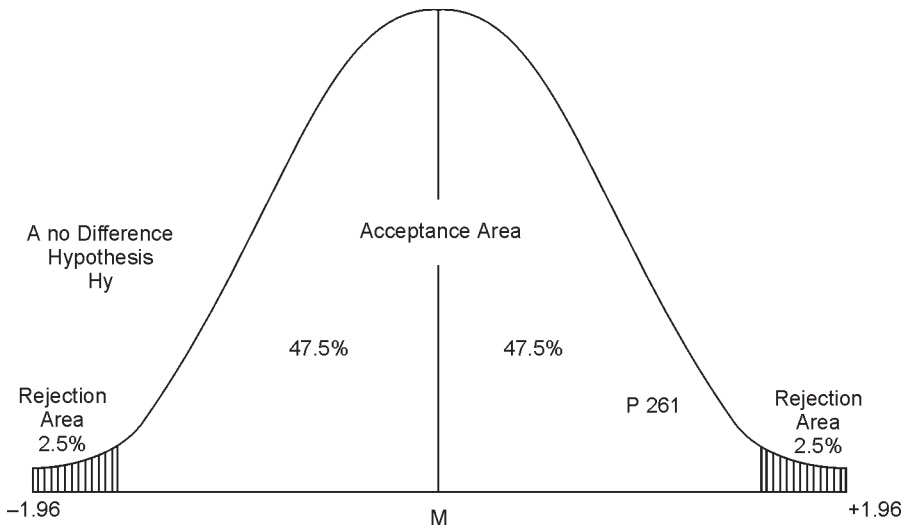
THE LEVEL OF SIGNIFICANCE

The rejection or acceptance of a null hypothesis is based upon some level of significance as a criterion. In psychological and educational circle the 5 per cent level of significance (.05) is often accepted as a standard for rejection. Rejecting the null hypothesis at the 5 per cent level indicates that a difference in means as large as that found between the experimental and control group means would not likely have resulted from sampling error in more than 5 out of 100 replication of the experiment. This suggests 95 per cent likelihood or probability that the difference was due to the experimental variable. A more rigorous test of significant is the 1 per cent level (.01).

When the samples are large (more than 30) the critical ratio is expressed as Z, or probability, score. If the critical ratio value exceeds 2.58, we may conclude that the difference between means is significant at the 1 per cent level. If the critical ratio value is greater than 1.96 but less than 2.58, we may conclude that the difference between means is significant at 5 per cent, but not at 1 per cent level. If the critical ratio is less than 1.96 the null hypothesis must be accepted at the 5 per cent level. .

TWO-TAILED OR NO DIFFERENCE TESTS

If a null hypothesis was established that there was no significant difference between the mean I.Q. scores of basketball letter winners and boys who did not participate, we would be' concerned only with a difference. We would not be concerned with the superiority of the letter winner group or that of the non- letter group. In such a case we apply a two tailed test.



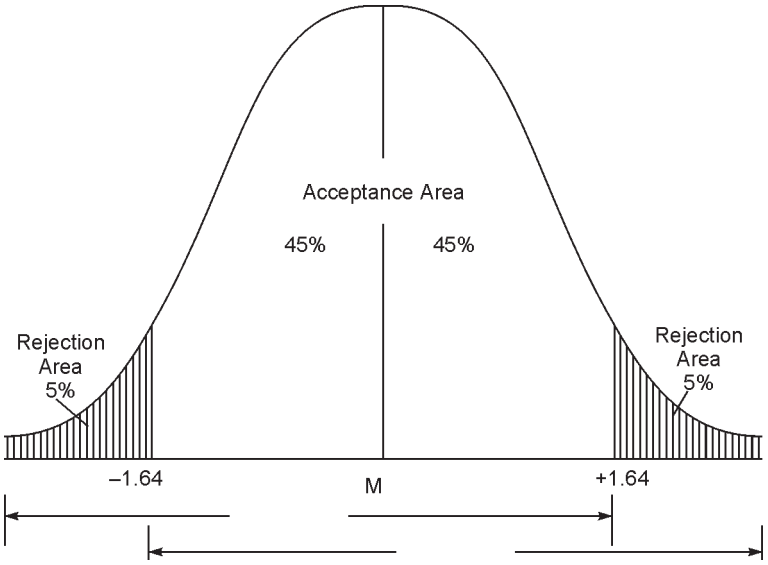
A two Tailed Test at the .05 Level

ONE TAILED OR DIRECTIONAL TEST

If we changed the null hypothesis to indicate a test of superiority of a particular group it might be started.

1. Athletes do not have lower I a mean scores than non athletes. or
2. Athletes do not have higher I a mean scores than non athletes.

Each null hypothesis indicates a direction of difference we are concerned with either higher or lower a mean for athlete group. When the researcher is interested in a direction of difference between groups, he uses a one tailed test. It can be noted that when 5 per cent rejection area is at one end or at the other end of the curve, it is not necessary to go out as far on the sigma scale to reach the 5 percent area of rejection.



A one tailed Test at the 0.5 Level

SIGMA VALUE THAT MUST BE EXCEEDED FOR REJECTION OF HYPOTHESIS

The sigma value exceeds, these table values for the rejection of null hypothesis.

Test	*Level of .05*	*Significance .01*
One tailed Test	1.64	2.33
Two tailed Test	1.96	2.58
Probability	.95	.99

THE SIGNIFICANCE OF *R*

To test the significance of a coefficient of correlation we may establish the null hypothesis that $r = 0$ and that any value of r, other than 0, is the possible result of sampling error. We assume that the sample r is one of a number of random samples. To use the z value and the probability table the r is converted

into *z* value by the formula.

$$z = r\sqrt{N-1}$$

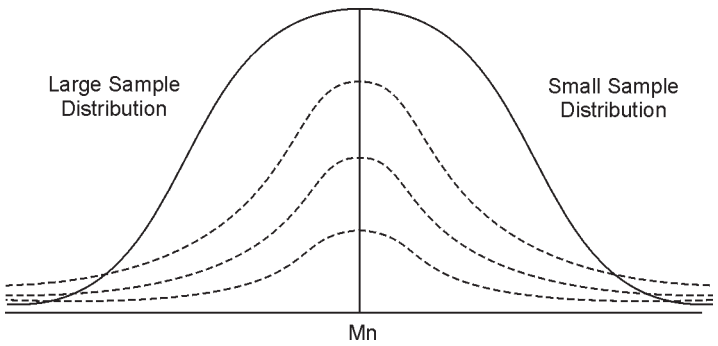
If *z* value exceeds the table value the hypothesis is rejected and if not then the hypothesis is accepted.

PRACTICAL SIGNIFICANCE

It is also important to note that a finding that is statistically significant may not be a measure of its usefulness in making a practical decision. A test of significance merely indicates there is a genuine relationship, that *r* is not *O*. Statistical significance indicates the probability that the finding did not result from sampling error.

STUDENT'S DISTRIBUTION '*t*'

When small samples, fewer than 30 observations in number, are involved, the *t*-test is used to determine the statistical significance. The concept of small sample sizes was developed by Gosset. Gosset determined that the distribution curves of small samples were somewhat different from the normal curve. Small sample distributions were observed to be higher at the mean and higher at the tails or ends of distribution.



Distribution of Large and Small sample means

Gosset's distribution, carefully calculated for small samples, is partially reproduced in t-table. The values necessary for rejection of a null hypothesis are higher for small samples at a given level of significance. As the sample size increases, the '*t*' values approaches the size '*z*' values of the normal probability table. To find the appropriate value necessary for rejection of the null hypothesis the number of degrees of freedom should be calculated.

For the test of significance of the difference between two means the number of degrees of freedom would be:

$$(N_1 - 1) + (N_2 - 1) = N_1 + N_2 - 2$$

For a test of significance of a small sample coefficient of correlation the number of degrees of freedom would be $(N - 2)$.

Many '*t*' tables list values at various degrees of freedom for rejection of the null hypothesis at .05 and the .01 level of significance.

To compute *t*-value for the significance of the difference between two means, when *N* is fewer than 30, the formula is :

$$t = \frac{(M_1 - M_2)}{\sqrt{\frac{(N_1 - 1)S_1^2 + (N_2 - 1)S_2^2}{N_1 + N_2 - 2}} \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$$

ANALYSIS OF VARIANCE (F) ANOVA TEST

The analysis of variance is a convenient way to determine whether the means of more than two random samples are too different to attribute to sampling error.

It would be possible to use a number of '*t*' test to determine the significance of the difference five means, two at a time, but it would involve ten separate tests. The number of the necessary pair wise comparisons of '*N*' things is determined by the formula:

$$\frac{N(N-1)}{2}$$

An analysis of variance would make this determination possible with a single test, rather than ten.

The question raised by the analysis of variance is whether the sample means differ from their own sample means (within group variance).

If the variation of sample means from the grand mean is greater enough than the variance of the individual scores from their sample means, the samples are different enough to reject a null hypothesis or sampling error explanation. If the among groups variance is not substantially greater than the within group variance, the samples are not significantly different and probably behave as random samples from the same population.

$$F = \frac{\text{Variance among groups}}{\text{Variance within groups}}$$

The significance of the '*f*'ratio is found in '*f*'tables which indicate the values necessary to reject the null hypothesis at the .05 or the .01 levels.

ANALYSIS OF COVARIANCE

The analysis of covariance represents an extension of analysis of variance, particularly useful when it has not been possible to compare randomly selected samples, a common situation is classroom experiments using available samples.

In such cases a pre-test is administered to each group before the application of the experimental variables. At the end of experimental period a post-test is administered and the gain evaluated by a test of covariance.

B. NON-PARAMETRIC TESTS

Non-parametric, or distribution free tests are used when the nature of the population distribution is not known or when the data are expressed as nominal or ordinal measures. The variables in a non-parametric

tests are usually presented in rank order or discrete values. Discrete data could represent such classifications as high, medium or low, urban or rural or male or female, counting number in each category.

Non-parametric Statistics for the Behavioural Sciences Sidney Siegel

There are many types of non-parametric tests which are most frequently used in the educational research studies. The basis for selecting the non-parametric statistics has been given in the following table:

Level of Measurement		Non-parametric Statistical Test				Non-parametric Measures of Correlation
	One Sample Case	Two Sample Case		K-Sample Cause		
		Related Sample	Independent Sample	Related Sample	Independent Sample	
Nominal	Binominal test x^2-one sample test	McNemar test for the significance of changes	Fisher exact probability test x^2-test for two independent samples	Cochran q test	x^2 test for independent samples	Contingency coefficient: c
Ordinal	Kolmogrov Smirnov One-sample test	Sign test Wilcoxon matched pairs signed ranks test	Meidan test, Mann-Whitney u-test	Friedman Two-way analysis of variance	Extension of meidan test	Spearman rank correlation coefficients; rs
	One-sample runs test		Kolmogro Smirnov two-sample test Wald-Walfowitz runs test Moss test of extreme reactions		Krushkal-Wallis one-way analysis of variance	Kendall rank correlation coefficient; r Kendall partial rank correlation coefficient t_{xyx} Kendall coefficient of concordance W
Interval		Walsh test Randomizat-ion test for matched	Randomizat-ion test for two independent samples			

CHI-SQUARE TEST (χ^2)

The Chi-square test applies only to discrete data (discrete variables are those expressed in frequency counts). The test is based upon the concept of independence the idea is that one variable is not affected by, or related to another.

For example, in a test in which 90 individuals are given a blindfold test in order to determine their selection of the mildest of three brands of cigarettes, the results could be interpreted by the Chi-square test.

If there were no significant differences preference we would expect the individual to choose brand. A, brand B or brand C in about equal proportion. On the basis of a null hypothesis any variation could possibly be attributed to sampling error. We would hypothesize that the choices were independent, or not related to any factor other than probability.

The test would provide a method of testing the difference between actual preferences and choices based upon a probability assumption.

The Chi-square formula:

$$\chi^2 = \Sigma\left[\frac{(f_0 - f_e)^2}{f_e}\right]$$

The differences in preference are greater than would likely result from sampling error.

Spearman Rank Order Coefficient of Correlation (ρ-Rho)

The Spearman rank order coefficient of correlation is a useful non-parametric test. The data are expressed in ranks rather than as scores. The test is useful when the number of ranked pairs is fewer than thirty and when there are few ties in rank.

$$\rho = 1 - \frac{6\Sigma d^2}{N(N_2 - 1)}$$

To test the significance of *p* (a one tailed test) we may use the '1' table (students distribution) for null hypothesis rejection values. The number of degrees of freedom is $(N - 2)$.

The ρ (rho) is converted to a *t* value by the formula

$$t_\rho = \frac{\rho\sqrt{(N-2)}}{\sqrt{(1-\rho^2)}}$$

If the '1' value exceeds the table value the hypothesis is rejected. If the '1' value fails to exceed the table values at the .01 and .05 levels of significance, the hypothesis that P = a must be accepted.

THE SIGN TEST

The sign test is sometimes used to evaluate the effect of a type of treatment in a before-after experiment. The sign test is based on the following assumptions;

1. The direction, not the amount of change in scores units is noted.
2. Cases in which there were no changes are disregarded.
3. The probabilities of a gain or loss are equal (P =.5). The sign test uses the principles of the standard error of a dichotomous variable; deriving a *Z*-score by the formula:

$$Z = \frac{O - NP}{\sqrt{NP(1-\rho)}}$$

where 0 = +ve changes
N = + and –ve changes
P =.5 (equal probability of a gain or loss)

If Z value exceeds the table value the null hypothesis is rejected and if not exceeded then the null hypothesis is accepted.

How to Make Analysis Objective

An investigator-analysis the tabulated material with a view to determining inherent facts or meanings. He breaks down existing complex factors into simpler parts and puts the parts together in new arrangement for the purpose of interpretation. The investigators make analysis objective by:

1. Picking out the essential elements in a problematic situation.
2. Separating similarities from dissimilarities.
3. Giving special attention to exceptions.
4. Arranging data on gently.
5. Making judgements on adequate data.
6. Making his sense of logic on sound principles.
7. Being inventive in the matter of techniques.
8. Disregarding personal attachment to a hypothesis.
9. Having good mathematical ability.
10. Studying data from as many angles as possible to find out new and newer facts.

SIGNIFICANCE

However valid, reliable and adequate the data may be, if they do not serve any worthwhile purpose unless they are carefully edited, systematical classified and tabulated, scientifically analyzed, intelligently interpreted and rationally concluded.

Barr and others point out, "Analysis is an important phase of the classification and summation of data into a summary."

According to A. Wolfe, "The discovery of order in the phenomena of nature, not withstanding their complexity and apparent confusion is rendered possible by the process of analysis and synthesis which are foundation stone of all scientific methods."

The types of statistical analysis of the data obtained in a research work are limited to the nature of data or to the type of scale of measurement one obtains by the process of quantification. The four scales investigated are: nominal, ordinal, equal interval, and ratio. Non-parametric statistics may be used to analysed data measured by the nominal or ordinal scale. Data measured by either the equal-interval or the ratio scale may be analysed by either non-parametric or parametric methods. Parametric statistics or tests are preferred if all the parametric assumptions are fully met and provided the researcher has great competence in the use of inferential statistics.

REVIEWING ASSUMPTIONS AND LIMITATIONS

In the final aspect of data analysis plan is for the researcher to look back over all the decisions and choices that have been made to identify two things: the final set of assumptions required for the project

to be sensible and the limitations to the conclusions which will hold if the current plans for the project are implemented. In identifying both assumptions and limitations the researcher is concerned with those aspects of the research process over which he has no control or about which he has no information. This includes aspects of the potential respondents, such as why some agreed to participate and others did not, or why after agreeing to participate some failed to complete the data gathering instrument, as well as the frankness of the base who did complete it. It may include aspects of the research approach, such as the availability of data in the historical approach, or the comparability of survey sites in the comparative survey, and often includes aspects of the research method such as the relevance of the time periods selected for observation or whether or not rapport was established in an interview.

Any controlled aspect which the researcher considers critical for the research to make sense must be stated as an assumption. Thus, the frankness of the respondents, the comparability of survey sites, the relevance of observation time periods in most projects would be considered assumptions because it makes no sense to report data from respondent who cannot be considered frank, or to do comparative study in sites or considered comparable, or to report observation data obtained during time periods which can not be considered relevant for the problem under study.

Those controlled aspects which are not critical may be stated as limitations to the conclusions. Thus, a researcher may decide that he can live with the fact that his historical project is limited to sources available.

Having stated the assumptions and limitations, and researcher should scan them as a total set and review them with one thought in mind, the impact on the audience to whom his research is directed. He must appraise the effect of his assumptions and limitations on the acceptance and implementation of his research findings and must be willing, even at this late stage, to revise or expand his research plans if one or more assumptions or limitations seem likely to damage the significance of the research too greatly. The researcher must build into the research atleast an overview of the materials of major significance in other languages. The research planning the comparative survey may conclude that simply saying he assumes that the several argument, and so decide to incorporate into his data gathering plan specific efforts to obtain data to verify comparability.

EXERCISES

1. Explain the phrase ‘Analysis of Data’ or ‘Treatment of Data’. Indicate the need and importance of data analysis.
2. Differentiate between descriptive statistical analysis and inferential statistical analysis.
3. Distinguish between parametric statistics and non-parametric statistics. Indicate their uses in different types of data or researches.
4. Describe the role of statistics and parameters in analysing the data. Illustrate your answer with suitable example.
5. What are the statistical technique which are commonly used in educational research?
6. Enumerate the important considerations for statistical analysis with special references to parametric statistics and non-parametric statistics.
7. Indicate the basis for selecting a statistical technique in analysing data for educational research.

Chapter 16

Research Report

The importance of a research study is to evaluate both scholastically and practically the contents of the written proposal and report of the study. The merit of the problem and its adequacy is examined on the basis of research proposal and the contribution of the study is judged on the basis of research report of thesis of the study. There are various formats of educational research report a researcher must understand its meaning and purpose. The following are the major writings formats of research work.

1. **Research Proposal or synopsis or outline of a research work or project.**
2. **Research Report or thesis**
3. **Research Summary, and**
4. **Research Abstracts.**

A research proposal deals with problem or topic that is to be investigated. It has a variety of formats which vary in their length. Writing a research proposal or synopsis includes an introductory section: problem hypotheses objectives, assumptions, method of study tools, justification and implications of the study. It is written in present or future tense. It covers four to ten pages. It is submitted for the final approval before starting the actual research work. The preparation of research proposal is significant in the development and pursuit of a research project. It is planning phase of a research work which is produced in the written form to judge its worth.

A research report deals with results of completed research work. After completing a research work, it is generally produced in the written ‘form, and is called research report or thesis. A detailed description of research activities are provided in it. It has a variety of formats and vary as to its length. It is written in past tense and in third person. It is the final form of the research work. A research report includes usually the following chapters-Introductory or theoretical background, Review of related literature, Methodology, Data collection, Analysis of data, Discussion of results and findings of the study, Bibliography and Appendices. It is also submitted for evaluating its contributions. It serves the purpose of communicating the results of a research work done.

A research summary is the condensed version of research report. It provides the important aspects of research report or thesis. The purpose of the summary is to facilitate the readers or other scholars to understand about work done at a glance because to go through a research report it is very time consuming and difficult. Therefore, the main features of research report are summarized. It takes the form of research journal article or paper. It is also written in the past tense and covers six to twelve pages.

A research abstract is the condensed version of research summary. The main essence of the research work when reduced to a page or para is called research abstract. It includes title, method, sample and findings of the study. These abstracts are published in the journal as Abstracts.

THE RESEARCH REPORT

The writing of research report is usually the concluding task of the research endeavour. Every thing is combined together during the writing of the report. This is the point at which the research must be essentially reproduced in written form. It is a matter of communicating what was done, what occurred, and what the results mean in a concise, understandable, accurate and logical manner.

This is not the difficult task because the researcher has gone through these tasks which he has to reproduce in the same order. Good research reports are not easily written. The report writing is a skill it must be acquired by the researcher.

Since the written report is an account of research project, the organization of the report follows quite closely the organization of the research project. The writing of the report is usually associated with the close of the research for project, few portions of writing may be done while the research study is in progress. The preliminary drafts of the review of the literature can be written and revised and brought upto-date later. Research procedures can be recorded as the project is conducted and while it is fresh in the researcher's mind. It is difficult to write from memory and avoid serious omissions.

The writer should assemble the available informations before taking to the writing work. Mechanical procedures for presenting foot notes, references, figures, tables and the like should be well in mind. In the interest of efficiency and continuity, relatively lot of time should be reserved for the writing work.

The research report should contain all the necessary data and at the same time it should be brief and to the point. There is usually considerable changing and rewriting before the final draft. The report is also known as thesis or dissertation.

NEED OF RESEARCH REPORT

Writing a research report is very challenging task for the researcher. A good research report requires sufficient-experience and insight about his research activities. A research report is needed due to the following reasons:

- The research must be reported in full and its results should be subjected to a criticism and verification.
- The research work is done for the benefit of human being, therefore, it must be communicable to the general public for the practical use.
- The research should be considered to be the culminating act for reflective thinking. It encourages other persons to take up some problem for further investigation.
- The research report requires the creative thinking of a researcher to review the related studies and discussing the result of the study and also suggest some new problems for further studies.
- The research report is also necessary for giving shape and form to the investigation and solidifying it.
- It is needed for providing a clear picture of research method, sample and techniques used in conducting the research work.
- The research report is meant for popularizing the new contributions in the discipline.

GENERAL FORMAT OF RESEARCH REPORT

A written format of a research work is known as thesis or research report. All such works may differ considerably in scope of treatment and details of presentation. Even then all types of research reports are expected to follow a general uniform, common pattern of format, style and structure. The general format of research report is evolved and it has become a tradition in academic area. A research report or thesis is an organized format of research work done. It is viewed in three major categories:

A. Preliminaries,
B. Textual Body, and
C. References.

Each category has been outlined further as follows:

A. Preliminary Section
   1. Title page
   2. Preface or acknowledgements
   3. Table of content
   4. List of tables (if any)
   5. List of figures (if any).

B. Main Body of Report or Textual Body
   1. Introduction
      (*a*) Statement of the problem
      (*b*) Objectives of the study
      (*c*) Hypotheses to be tested
      (*d*) Significance of the problem
      (*e*) Assumptions and delimitations.
      (*f*) Definitions of Important terms used.
   2. Review of related literature.
   3. Design of the study
      (*a*) Method and procedure used
      (*b*) Tools of research or sources of data
      (*c*) Techniques of data collection
      (*d*) Description of techniques used.
   3. Analysis and presentation of data
      (*a*) Analysis of data
      (*b*) Tables and interpretation
      (*c*) Figures and interpretation.
   4. Conclusions
      (*a*) Discussion of results
      (*b*) Main Findings and inferences
      (*c*) Implication of the findings and limitations
      (*d*) Suggestions for further studies.

C. Reference Section
   1. Bibliography
   2. Appendices (if any)
   3. Index or glossary (if any).

The detailed explanation of each aspect is given here

A. PRELIMINARY SECTION

As the preliminaries form a significant part of the whole thesis report, due care should be taken in preparing them. If the specifications are already laid down by some colleges or universities they should be observed. However, a general standard pattern suggested here in each case will be helpful for a researcher.

1. Title Page

This is the first page of a thesis or a dissertation. It includes:

(*a*) Title of thesis.

(*b*) Name of the candidate.

(*c*) Purpose or relationship of the thesis to the course or degree requirement.

(*d*) College and/or department in which the candidate has been admitted for the degree.

(*e*) Name of the university to which it is submitted.

(*f*) Month and year of submission or acceptance.

The title should be accurate, concise and clearly printed in capital letters. It should convey the main theme of the problem investigated and if possible one should give a clue about the method or type of research involved. A specimen of title page has been presented here.

2. Preface or Acknowledgement

A preface is different from introduction. It is a brief account of the purport or the origin and the utility of the study for which the thesis is presented. It also includes the acknowledgement to the persons and sources that have been helpful to the investigator. If the researcher does not want to mention anything about the study on this page except acknowledging debt to others, it will be desirable to use the title simple and restrained without flattery and effusive recognition for help by the family members and others. The preface should not be too long with too many details about the research work or its organization, which can appear in introduction. The word PREFACE or ACKNOWLEDGEMENT should be typed in capital letters. It should be written in an impressive way.

3. Table of Contents

This section lists all the main chapter headings and the essential sub-heading in each with the appropriate page numbers against each. The listing of main chapters is generally preceded by some preliminaries like preface or acknowledgement, list of tables, list of figures, abstract or synopsis and their respective pages in small Roman numbers and followed at the end by appendices, and Indexes.

Contents should neither be too detailed nor too sketchy the table of contents should serve an important purpose in providing an outline of the contents of the report. The capitalized title ‘Contents’ should be the central heading of the page and the capitalized word ‘CHAPTER’ and ‘PAGE’ should-

lead to the numbers of chapters and those of pages respectively on the left and right margins. An example' has' been given in the tabular of form.

4. List of Tables

The table of contents is followed by the list of tables on a separate page. This list of tables consists of the titles or captions of the tables included "in the thesis along with the page number where these can be located. It has been illustrated here.

The capitalized title 'LIST OF TABLES' should be the central heading of the page and the capital words 'TABLE' and 'PAGE' should lead to the numbers and those of pages respectively at left and right margins.

5. List of Figures and Illustrations

If any charts graphs or any other illustrations are used in the thesis, a list of figures on a separate page is prepared in the same form as the list of tables except that they are numbered with Arabic numbers. An example has been given here for this -purpose.

Table of Contents

CONTENTS

LIST OF TABLES

Similarly list-of figures is prepared. The page number of figures is given facing the page number of the report.

(B) MAIN BODY OF REPORT OR TEXTUAL BODY

The text of the thesis is the most important section in the organization of research report. The quality of worth of thesis is mainly examined. It is the original production of the researcher. The report of the main body serves the function of demonstrating the competence of the researcher. If any sentence, paragraph, concept fails to serve the single function within a given section or chapter, it is irrelevant The subject matter of any chapter should be relevant to that point. Generally the main body of the research reports consists of five or six chapters.

Chapter

I. Introduction or Theoretical Frame Work
II. Review of Related Literature
III. Design or Methodology
IV. Data Collection or Administration of Tools and Scoring.
V. Analysis and Interpretation of Data.
VI. Conclusions and Suggestions for the Further Researches.

Chapter 1. Introduction or Theoretical Frame Work

The main purpose of this chapter is to indicate the need and scope of the study. It consists essentially of the statement of research inquiry. It is reported in past tense form of work completed. The problem objectives, hypotheses, assumptions and delimitations of the study are reported precisely.

If an introduction is required, the researcher should make certain that it is an introduction that generates an interest and appropriate mental set which introductions are regarded as capable of producing. It must be long enough to do its jobs and nothing more.

Chapter 2. Review of Related Literature

This chapter is essential in most of the research studies. It presents the comprehensive development of the problem background. It Indicates what has already been studied by others, which has a bearing upon the present study.

The review of literature stresses two aspects: the first is the consideration of the subject-matter and it is likely more important than the other. The second is related to methodology and design. The review chapter is devoted to the development of the problem statement or the object of the inquiry. The review is utilized to retain a direct relevancy to the study in hand. It is the balancing chapter of the research report.

Chapter 3. Design or Methodology of Research

This chapter indicates the line of approach of the study. The first aspect deals with the method, population and sample of the study and second part provides the tools and techniques employed in the research. It also presents the procedure of the study. The whole plan of the study is discussed in detail under this chapter.

Administration of tools and scoring procedure are reported systematically. The data organization and presentation should be given in this section. It may be reported in a separate chapter of the report.

Chapter 4. Analysis and Interpretation of the Data

In this chapter analysis and results are reported so as to draw the inferences of the study. The analysis of data are presented in tabular form and in figures or pictorial presentation. The results are interpreted at length. This chapter provides the original work or contribution by the researcher. The communicative accuracy is required in this chapter. The text must be developed to ensure an effective ordering of the evidences.

Chapter 5. Conclusions and Suggestions

This is most important chapter of the report. It requires the creative and reflective aspect of the researcher. The results are discussed to make them more meaningful comparison of the results with the evidence in the review section should be woven into the text whenever such a discussion can serve to clarify the points being reported. This is the final chapter of a report, thus findings of the study are summarized and suggestions for the further studies are also given. The implications and delimitations of the findings are also mentioned in this section. The main thrust in the section is the answer of the question or solution of the problem. The validity of the findings should be mentioned.

(C) REFERENCE SECTION

This is the third section of a research report. It consists of generally the bibliography and appendice. It is also essential to include glossary and index for the convenience of the readers. The bibliography, appendix, glossary and index all these are written on a separate page - in the centre with capital letters.

1. Bibliography

The bibliography is a list of the printed sources utilized in the research work. The publications used for information-yield but not quoted in the report may also be included in the bibliography. The format of the bibliography depend on the footnote style. If the foot-notes reference in the text are numbered to refer to the source in the bibliography, the entries must be numerically listed in the order of appearance in the text. The various format manuals include information on form for the bibliography. If the list of sources is too large the bibliography should be categorized in the following sections:

Books, monographs, documents and reports, periodicals and journals, essay and articles, unpublished thesis and material and newspapers.

If selected sources are reported the words ‘Selected Bibliography’ should be written. In writing bibliography the surname is written first than initials, year of publication, title of the book, publishers name, place and total number of pages. The following are the examples of writing bibliography:

(*i*) Example for single author:

Best, John. W (1977) ‘Research in Education’, 3rd ed., New Jersy : Prentice-Hall Inc. Englewood Cliffs, 403 pp.

(*ii*) Example for two authors: The only difference is that second author’s name is written differently i.e. initial first and surname at the end in a usual manner.

McGrath, J.H. and D. Gene Watts on (1970) ‘Research Methods and Designs for Education’ Pennsylvania: International Text-Book Company, 222 pp.

(*iii*) Example for three or more authors:
Selltiz, Claire et al. (1959) "Research Method in Social Relations', New York: Holt, Rinehart and Winston, 424 pp.

(*iv*) Example for editor as author:
Buros, Oscar K. ed. (1965) 'The Sixth Mental Measurement', Yearbook: Highland Park, N.J. : Gryphon Press 1163 pp.

(*v*) Example for author not given:
Author's Guide (1955) Englewood Cliffs, N.J. Prentice Hall, 121 pp.

(*vi*) Example for publication of an association, Agency or Society:
National Society for the study of Education (1955), 'Modern Philosophies of Education' 54th Yearbook, Part-I, The University of Chicago Press, Chicago 37 pp.
Or
'Modern Philosophies of Education' (1955), National Society for the Study of Education, 54th Yearbook Part-I, Chicago: The Chicago University Press 374 pp.

(*vii*) Example for unpublished thesis:
Sharma, R.A. (1972), 'Some Predictors of Teacher Effectiveness' Unpublished" Ph.D. Thesis Submitted to Meerut University, 320 pp.

(*viii*) Article in an Encyclopaedia and Hand Book.
Barr, A.S. (1944), 'Criteria of Teacher-Effectiveness' Ebel's Encyclopaedia of Educational Research, 742 p.
Smith, B.O. (1964), 'Relationship of Teaching and Learning', Gage, Hand Book of Research in Teaching, 426 p.

(*ix*) Example for Journals and Periodicals:
Bar, A.S. (1940), 'The Measurement and Prediction of Teaching Efficiency,' Review of Educational Research, Vol. 10, No. 4, pp. 185-190.
Leeds, C.H. (1969), Predictive Validity of MTAII', The Journal of Teacher Education, Vol. 20 NO.1.

(*x*) A chapter written by an author other than the editor:
Maccoby E.E. (1954), 'The Interview: A Tool of Social Science',' Chapter 12, in the Hand Book of Social Psychology, Addison, Wesley Cambridge Mass.

(*xi*) Quotations primary source cannot be located:
Kelley, E.P. (1950), 'Education for what is Real', As cited by Edward A. Krug, 'Curriculum Planning', New York: Harper and Row Publishers, 55 pp.
The place of publication may be written before the home of publishers e.g. New York: Harper and Row Publishers, 55 pp.

A bibliography reference is written in the following manner and arranged alphabetically to facilitate the readers:

- Name of the author with the last name first and initials afterwards.
- The year of publication is given in bracket after the name of the author and authors.
- Title of the book or the work is written, underlined and followed by a full stop (.).
- Place of Publication followed by a colon (:).

- Name of the publishing agency and publishers and followed by comma (,).
- Total pages of the book are given.

The above sequence is employed in preparing bibliographical references. It is also used for giving footnotes reference with a little deviation. In footnote the name of the author with the Initials first followed by surname or last name is given. The specific page number of the work or the book is given not the total pages. Other things remain the same as mentioned in the bibliography. The bibliography pages are also written in Arabic figure in the sequence of main body of the report.

2. Appendix

An appendix is the important reference materials category. It includes the material which can not be logically included in the main body or textual body of the research report or the relevant materials too unwieldy to include in the main body. The appendix usually includes: tools of research, statistical tables and sometime raw-data (when data were processed through computer). Even the material of minor importance e.g. forms, letters, reminders, interview sheets, blank questionnaires, charts, tables, lengthy questions, report of cases (if follow-up or case studies have been conducted). The tools and other material should be placed first and tables at the end and page numbers should be assigned in Roman Numbers (i, ii, xxi). The appendix serves the function of providing greater clarity and authenticity for the readers or consumers of the thesis. The items of the appendix are very essential for a good research report.

3. Index and Glossary

When a research report is published in index, must be given. The index includes authors and subjects and topics or words in alphabetical order.

In the report glossary should be provided. It includes the meanings or definitions of some words and terms ‘used in the research report. Some notations symbols or abbreviations should be explained what actually they mean or indicate in the study.

MECHANICS OF REPORT WRITING

A research report writing is a highly technical activity. It includes various mechanics for a smooth flow of the thesis. The mechanical aspect has been standardized which must be followed by researcher in preparing a thesis. Such mechanics involve the following issues:

(*a*) Footnotes and references,
(*b*) Style of writing,
(*c*) Headings,
(*d*) Tables,
(*e*) Figures,
(*f*) Pagination,
(*g*) Proof reading, and
(*h*) Binding and submission.

(*a*) Footnotes

Sometimes it is desirable to quote some authoritative views or statements from written works of others in the research report. It may be necessary from various purposes viz. to review the related literature, to support to give the rationale for one's viewpoint.

Each quotation must have a footnote or reference indicating the sources from which it is borrowed. All these sources and authority be acknowledged both for intellectual honesty and for validity of one's research.

Footnotes serve a number of purposes. They enable the researcher to substantiate his presentation by quotations or citations of other authorities, to give credit to sources of material that he has reported and to provide the reader with specific sources that he may use to verify the authenticity and accuracy of material quoted. The citation or quoted statements are written in single-spaced whereas the text is written double-spaced.

The footnotes are placed at the bottom of the page" and are separated from the text by a three cms horizontal line drawn from the left margin. Footnotes are numbered consecutively within a chapter.

The recent approach is that references are given in the place of footnotes. The reference of quoted material is inserted in parentheses at the end of the sentence. For example, (4 : 72) indicates that the statement refers to the bibliography listing number 4, page 72. Another procedure is that all the references are placed on one page at the end of the chapter in the sequence of quoted statements.

Method of Writing Footnotes: Usually the footnotes are given at bottom of the page at the end of the text according to the number of quotations provided on it. The following examples illustrate the style of writing footnotes:

1. Single author

   John W. Best. (1977), 'Research in Education' 3rd ed. New Jersey: Prentice-Hall, Inc., Englewood Cliff, 84 p.

2. Two authors:

   J.H. MC. Grath and D. Gene Wattson (1970), 'Research Methods and Designs for Education', Pennsylvania International Text-book Company, 124 p.

It may be noted from the examples of footnotes and bibliography that the author's last name or surname is written first in bibliography while last name or surname is given in usual way or in the last. Second difference between these two can be gathered regarding page-total number pages of the book are written in bibliography and specific page number of the book is recorded on the foot-notes where the quotation has been given in the book. In this way eleven types of bibliography have been illustrated in this chapter, with this difference eleven types of footnotes can also be written.

To avoid repetition and making economy of time and space some abbreviations are used in writing the footnotes references. Usually following three types of abbreviations are employed.

Ibid–In consecutive reference to the same work the Latin abbreviation Ibid (Indicates same page as earlier footnote), Ibid p. 36 (same work, but a different page 36) is used.

Qp. Ci.–When a reference to the same work is not used in consecutive but after some other references, the Latin abbreviation op. cit. (indicates the work already cited in the report). The surname of the author and op. cit. is used. If the page number of the book is different, in this situation op. cit. and page number along the surname is used. The examples are as follows:

Chaube, op. cit (the work cited).

Chaube, op. cit. page 48 (the work cited on page 48).

Loc. Ci. – When a second but non-consecutive reference follows, referring to the same work and same page, the Latin abbreviation Loc-cit (previously cited) may be used. The authors surname along Loc. cit must be included. An example is given below:

Chaturvedi, Loc. cit (previously cited on page 48).

(*b*) Style of Preparing Thesis

The research report should be written in a style that it is creative, clear and concise. Therefore the following considerations should be kept in view in writing a research report.

1. The research must be reported in full and its results are subjected to criticism and verification.
2. A research report is always written in third person i.e. he, she or the investigator. I, we, you, my, our and us should not be used.
3. It is prepared and written in past tense and present-prefect tense because it is reported usually after completion of the work.
4. The scientific language is used rather than literary language. The British-English pattern is followed in writing a research report. The spellings of the words are employed of the British English.
5. It is typed printed/cyclostyled on 11″ 9″ size (thesis size) sunlit bond papers. There should be left a margin of 1-1/2″ right margin one inch top and bottom margin should be 1-1/4″ in each. The same machine of typing must be used for typing research report.
6. The presentation of matter should be in floating sequence. There should be consistency in the form and content organization.
7. An appropriate and proper format of research report should be used.
8. The footnotes, references, tables, figures, heading, subheading and bibliography should be provided in its standard form.
9. It should be typed in double space, quotations or citation should be given in single space. A word should not be split in two aspects due to the shortage of space in a line. A table, figure and diagram should always be given on a single pace. If table size is large. a large size paper should be used. It should not continue on the next page.
10. A typist with great experience and proficiency should be employed for preparing thesis or dissertation, because it is the responsibility of the researcher that a thesis should be typed in proper form. The correction of major errors is not the responsibility of the typist.
11. Good research reports are not written hurriedly. Even an expert and experienced researcher revises many times before he submits a manuscript for typing. Typographical standards for the thesis or dissertation are more exacting. Therefore, every typist cannot prepare a thesis, there are the experts for typing thesis, who should be employed for typing thesis.

(c) Headings

Generally a research report is divided into chapters, each chapter begins from a new page. The title of a chapter is called the chapter heading. The work ‘CHAPTER’ is written in capital letters, in the centre of the page and title is placed three spaces of the chapter. The following is the example:

CHAPTER IV. IDENTIFICATION OF TEACHING SKILLS

(Chapter Heading)

Major Heading: A chapter of the report is divided into major heads. The major heading is written in capital letters at the centre of the page. An example is as follows:

STIMULUS VARIATION SKILL

(Major Heading)

Major Heading: A major heading is sometimes divided into sub headings which are known as minor heading. It starts with left margin of a page in lower-upper letters. A paragraph starts two spaces below. An example is given below:

Components of Stimulus Variation Skill: (Minor Heading)

Paragraph Heading: If the minor heading is further divided, the paragraph is used. It must be indented five spaces and underlined. A full stop and dash is marked after such a heading. The written matter starts on the same line. The following is an example:

Change in Voice: There is a modulation in the voice of effective teachers. (Paragraph heading).

These headings are also specified by using the numbers. For the Main headings 1, 2, 3, 4...so on are assigned in a chapter. The minor headings or sub-heading are shown in decimal numbers e.g. 2.1, 2.2, 2.3, it indicates that 1, 2, 3 are the minor headings of second main heading. Similarly paragraph headings are indicated in further decimal numbers e.g. 2.1.1, 2.1.2, 2.1.3 last numbers, 1, 2, 3 are paragraph headings of first minor heading of second major heading.

(d) Tables

A table is used for presenting statistical data. It enables the readers to comprehend and interpret data quickly and to understand significant aspects at a glance.

The work 'TABLE' is followed by the serial Roman number which is placed at the centre two spaces above the title of the table. The title of the table is written in capital letters at the centre of the page. The statistical data are presented in vertical columns and horizontal row, according to some classification of subject matter. An example has been given below:

TABLE - XII

STRUCTURE OF SAMPLE SUBJECTS

With Regard To Sex and Age

Years	*Boys*	*Girls*	*Total*
25	10	6	16
22	12	8	20
–	–	–	–
–	–	–	–
–	–	–	–

(e) Figures

A figure is a device that presents statistical data in pictorial or visual form. The figure is used to a variety of graphs, charts, maps, sketches, diagrams and drawings. It helps to understand the aspects of data clearly and easily. One idea or fact should be presented in each figure. The description of the figure must be given in the textual body. 'FIGURE' should be written in the centre of the page at the top of the figure. The title of the figure should be written in capital letters two spaces below the figure. The scale of the figure must be given. An example has been provided here.

FIGURE-12

GROWTH OF LITERACY IN INDIA

In Millions (During 1950-80)

The bar diagram and graphical presentations (Polygons and Histogram) are commonly used in educational research reports.

(f) Pagination

Assigning page numbers of the report is very essential. The title page or initial page of any section does not have a page number typed on it, but a number is allotted to it in the series of pages. Page numbers are typed in the upper right hand corner, one inch below the top edge of the page.

The small or lower Roman numerals (i, ii, iii, iv,) are assigned for the pages of preliminary section. The serial Arabic nos. 1, 2, 3, 4…..so on are assigned for the pages of textual body or main body of the report i.e. Chapter I to last and Bibliography. The lower Roman numerals are assigned for the pages of appendices and index. The correct pagination depends upon the final edited copy or typed copy.

(g) Proof Reading

A research report should not have errors. It requires that final typed copies must be checked carefully. All types of errors should be deleted before submission. Thus, proof reading of final typed copies should be done two or three times. The following are the some practical suggestions with regard to the technique of corrections:

- Generally four or five copies are prepared for the final report. The last typed copy should be taken for correction purpose.
- The last typed copy should be read thoroughly, the errors should be recorded on a separate page indicating page number, para number, line number and kind of error. It should be corrected with help of black refill.
- The addition or deletion or more than one word or sentence or line is required for the correction, it should be made by the typist on the same machine.
- With the help of the proper on which errors have been noted down, correction of minor errors can be made quickly and easily in the remaining three or four typed copies of the report.

(h) Binding and Submission

It is the last activity for preparing research report. Before giving to the binder it should be arranged properly and systematically and the serial number of pages are checked carefully. It should be given to

an expert binder who has the experience of binding research thesis. Some universities require three copies of the thesis five copies of the abstract or summary and three copies of synopsis. These should also be prepared. A great precaution must be taken in printing the topic or title of the thesis that it must be the photo-state form of the topic which was approved by research degree committee. The covering page must be the same as inner cover given in preliminary section.

After binding the thesis it should be submitted to the university for evaluation purpose. Researcher should ascertain the date of submission and other requirement e.g. certificate of the supervisor. evaluation fees etc. For the post-graduate dissertation. student should plan that he would be able to submit to college or university in time. He must obtain the receipt of the submission of his thesis.

EVALUATION OF A RESEARCH REPORT

The evaluation of a research report is a valuable exercise for the student of educational research. Using a pattern such as the one suggested, the critical analysis of the many aspects of another researcher's report helps the student to develop competency in his own research and reporting skills. The evaluation aspect is much more useful even to a guide or supervisor for instructing his research scholars in preparing a research report.

The following questions are suggested relating to the various aspects of research report as a possible structure for the analysis:

1. **The Title**
   - (*a*) Is it clear and concise?
   - (*b*) Does it promise no more than the study can provide?
2. **The Problem**
   - (*a*) Is it clearly stated?
   - (*b*) Is it properly delimited?
   - (*c*) Is its significance recognized?
   - (*d*) Are specific questions raised and hypotheses are clearly stated?
   - (*e*) Are the assumptions and limitations stated?
   - (*f*) Are important terms defined?
3. **Review of Related Literature**
   - (*a*) Is it adequately covered?
   - (*b*) Are important findings-noted?
   - (*c*) Is it well organized?
   - (*d*) Is an effective summary provided?
   - (*e*) Is the researcher commented adequately? Has he justified that his study is related to the studies and has the deviations from earlier studies.
4. **Methodology** used for conducting the study:
   - (*a*) Is the research design described in detail ?
   - (*b*) Is the method adequate?
   - (*c*) Is the population defined properly?
   - (*d*) Is the sample described?
   - (*c*) Are the relevant variables recognized?

(*f*) Are appropriate controls provided?
(*g*) Are data collecting tools appropriate?
(*h*) Are validity and reliability established?
(*i*) Is the statistical treatment appropriate?

5. Data Analysis

(*a*) Is appropriate use made of tables and figures?
(*b*) Is the textual discussion clear and concise?
(*c*) Is the analysis of data relationships logical and perceptive?
(*d*) Is the statistical analysis accurately interpreted?

6. Conclusions and Suggestions

(*a*) Are the results discussed at length adequately?
(*b*) Are the inferences stated appropriately?
(*c*) Are the limitations of the findings enumerated clearly
(*d*) Are the applications of the findings suggested adequately?
(*e*) Are some suggestions for further studies proposed appropriately?

Apart from these aspects of research report, its literary presentation should be worth for publications. There should be minimum or no typing errors. The researcher should have the confidence aware of the limitations of his study.

WRITING RESEARCH ABSTRACT

A well written abstract is a great service to every one who is going through the research process. Abstracts are main method which is used to communicate research findings and contributions to the works of the field studied. Generally a researcher has to prepare an abstract after completing his research thesis or report. There are two procedures in this regard:

- The abstract is provided in the main body of the research report in the form of last chapter of the thesis.
- The abstract or summary of the report is prepared separately in a booklet form.

Most of the universities require some copies of the abstract at the time of a submission of a thesis for evaluation purpose. It facilitates the examiners or experts to evaluate a research thesis properly.

Need of an Abstract

The following are the main advantages of a research abstract:

1. Generally research reports are voluminous and hence these require time and energy to go through them. An abstract provides the awareness of the research work at a glance. It facilitates the readers and other research works to comprehend it easily and quickly. It means to communicate a research contribution in the field.
2. The experts or examiners make use of the abstract in evaluating research thesis. 'It communicates the work done by researcher and review same of the aspects wherever they require further clarifications.

The abstracts are used by other researchers of the field to review the studies conducted in this area. It is an economical device far reviewing the related studies.

The research papers are prepared with the help of the abstract. These papers are published in research journals and papers to disseminate the knowledge in the area.

The research organizations universities and institutes can register the research abstracts for financial assistance. The research thesis is approved for publication and the basis of reviewing abstract and financial assistance is granted for its publication.

In a particular field of research 'Research Abstract' is prepared. The Survey of Educational Research in India by such is prepared by collecting these abstracts from Indian Universities and faculty of education.

Format of Abstract

A summary of a research report or thesis is prepared in the form of abstract. It provides the brief description of main points of research report. The main theme is given in the abstract of a research work. Its size varies from 4 to 12 pages, but there is no hard and fast rule in this regard. It should be able to communicate the whole work comprehensively. There are two formats for preparing abstract:

First Type Format: Includes main points and theme of research work in brief. It includes the following points: Introduction, main body of the text and conclusions. The introduction part covers the problem, adjectives, hypothesis and theoretical aspect. The main body of the text includes method sample techniques, tools used results. The last part of abstract provides the conclusions of the study in the statement form along with their implications in the field. This type of format is used in scientific studies in the discipline of education.

Second Type Format: Includes the summary of the chapters of the research report. The main theme of each chapter is given in this type of format of abstract. This format is used in philosophical, historical and descriptive type of research in the area of education.

Usually a research abstract consists of three main parts:

- Introduction,
- Main Body of the report, and
- Conclusions.

The introductory part emphasizes the significance of the problem, objectives and hypotheses (if any) of the study. The main body includes methods, sampling, techniques, tools and results of the study. The last part provides contributions or conclusions of the study. The implication of the findings are also highlighted at the end. The structure of the report is also given and most important references are also written in the form of bibliography. The abstract is written in past tense and in the third person.

Characteristics of a Good Abstract

A good abstract has the following characteristics:

1. It is economical device to communicate the contributions of a research work.
2. A good abstract is written in simple and clear language. The words and terms used should have single meaning.
3. An abstract disseminates the new knowledge in field studied.
4. It avoids the repetition of research studies.
5. It helps the researcher to review the related study in an economical way from time, money and energy point of view. A good abstract brings the name of researcher in the field through a significant contributions.

7. The specialist or experts give their comments and suggestions for further investigation.
8. A good abstract provides the basis for preparing research papers.

It is the media and method to popularize a research contributions and to provide its implications for improving in a particular area of education.

WRITING RESEARCH PAPERS

Research is a critical, disciplined, inquiry into a problem. A research paper is a presentation of the result of such a critical inquiry. Writing a research paper involves certain procedures which, is followed in proper sequence, might avoid waste of time, energy and resources.

The writer of a research article has to rely on two kinds of source of information called as primary and secondary on the basis of the evaluation of their trust worthiness. Similarly, he has to be extremely cautious in the discrimination between facts and opinions though both are important elements in his arguments and chain of reasoning. A 'fact' is anything which is known to exist or which is accepted as true. There is no need to substantiate well known facts like the birth dates of contemporary leaders or events. A research paper has to present a number of opinions as expressed by others or researcher himself. It is necessary to document those opinions of others by pin- pointing their sources so that anyone if in doubt can "verify any of them. It is a sound policy and good convention to keep facts separated from opinions, especially the author's own, in a research paper. Any mixture of them there will lower the credibility of the paper as a scholarly piece of writing.

Format of A Research Paper

There is no fixed format 1 for writing a research paper. Each individual has to develop his own approach. But a broad guideline can be evolved on the basis of experiences of many researchers. An outline of the research paper should be prepared before details are written down. A good outline will help in the proper structuring or designing of a research paper. It will involve all the relevant points in an effective sequence which will provide direction to the flow of writing research paper. Before an outline is prepared, it will be necessary to make a list of all the points and to determine their status either as major, or supplementary materials. A working outline can be prepared by combining these points in a paper sequence.

The format of research paper usually includes three main points: An introduction, the main body of text and conclusions. It is possible to make a good beginning with a relevant quotation which is not too familiar. It should attract attention and arouse curiosity. A paper may begin by a good summary of the research paper or research work done on the topic in the past. It should be objective survey in very brief. The important references to the sources used for this survey will enable the writer to demonstrate familiarity with the key concepts, theories, latest developments in research and prevailing controversies.

The introduction is also a place where the central problem is clearly stated. The central theme should be brought into focus along with its significance.

The main body of the paper should be developed to the report of the research work to the presentation of arguments based on the work of exploration, discoveries experiments, analysis, synthesis or all those activities which constituted the research and led to the conclusions. A research paper will have constructive and critical sides. The constructive paper should follow in order to prove how the research reported in the paper fills the void.

But another approach is equally welcome in which the contribution of the research is presented first. Its significance is highlighted by critical refutation of the claims of the rival theories. In any case, what the researcher has done should be brought into focus. The views of the researcher should be supported by references statistics and other form of evidences.

The paper should have a conclusion in which the quintessence of the work is reiterated preceded by a recapitulation of the main arguments or statements of the research work. The first draft of a paper may not be the most satisfactory though it may look so at the time of writing. Most experienced writers set aside the first draft for a few days, at least for a few hours. This process helps in a more impersonal critical and objective reappraisal. Any paper improves with revision or rewriting and the research paper is no exception. It will help the writer if he imagines himself addressing the most renowned scholars in the field while writing the paper in the first place and later in its finalization.

Advantages of a Research Paper

A research paper has the following main advantages:

1. The new contribution in the specific area is disseminated among other research scholars.
2. The repetition can be avoided others will not take up the same problem.
3. It saves the time energy and money in the research area.
4. A research worker is also known through the research papers that he is working in a particular field.
5. The experts of the area may comment or suggest for the researcher to design further study.
6. The research-worker learns and gains experience for writing good research paper.

EXERCISES

1. Explain the following terms used in a research.
   (*a*) Research proposal or synopsis or outline of a research project,
   (*b*) Research report, or thesis or dissertation,
   (*c*) Research summary, and
   (*d*) Research abstracts.
2. What do you understand by research report or thesis? Indicate its need and importance in the research work.
3. Indicate the general format of research report and mention its specific category of each major section of report.
4. Differentiate between bibliography and footnotes or references. Illustrate your answer with examples.
5. Point out the mechanics of report writing and illustrate your answer with examples.

Chapter 17

Action Research

The concept of managing learner, models of teaching and teaching levels has been discussed in earlier chapters. The pupil-teacher can make use of these concepts in planning and organizing effective teaching and realizing the objectives of teaching. A teacher has to see several types of problems in his presentation and achieving the learner objectives. Therefore, it is an essential for a teacher to solve that problem scientifically. The appropriate teaching strategies may not be useful until and unless these problems are solved.

Employing the action research device can solve the classroom problems. It is a method for solving the problems of teaching objectively and systematically. This is useful for improving and modifying the teaching process. The theoretical and practical aspects of action research concept have been discussed in this chapter.

MEANING OF ACTION RESEARCH

Action research is a method for improving and modifying the working system of a classroom in school. The teachers and principal are able to study their problems of teaching scientifically. It is an objective oriented method. The action research project does not contribute in the fund of knowledge but it improves and modifies the current practices. Hence it is necessary to understand the concept of 'Research' to have correct idea of the term 'Action Research'.

MEANING OF RESEARCH

Research is a process to study the basic problems, which contribute in the edifice of human knowledge. The research process established new truth, finds out new facts, formulates new theory and suggests new applications. It is a purposeful activity that contributes to the edifice of knowledge. Random Morey has defined the term 'research'.

"Research is systematized effort to gain new knowledge." P. M. Cook has given a comprehensive and functional definition of the term research:

"Research is an honest, exhaustive, intelligent searching for facts and their meanings or implication with reference to a given problem. The product or findings of a given piece of research should be an authentic, verifiable and contribution to knowledge in the field studied."

He has emphasis on the following characteristics of research in these definitions:

1. It is an honest and exhaustive process.
2. The facts are studied with understanding.
3. The facts are discovered in the light of problem. Research is problem-oriented.
4. The findings are valid and verifiable.
5. Research work should contribute new knowledge in the field studied.

All the definitions of research have some characteristics:

(*i*) Research arise for contributing new knowledge by studying some problem

(*ii*) Research is objective and scientific process for studying the problems in a discipline.

MEANING OF EDUCATIONAL RESEARCH

The main focus of education is on the development of a child. The teaching process brings the desirable change among learners. The basic problems of teaching and education are studied in educational research. W. M. Traverse has defined the term "educational research." Educational Research is that activity which is directed' towards the development of science of behaviour in educational situation." F. L. Whtney has defined the term educational research comprehensively:

"Educational research aims to make contribution towards the scientific-philosophical method, the method of critical reflective of experience which are organized and evaluated which result in hypotheses and theories each successively subjected to deductive longer generalization constantly approaching truth in the field investigated."

Whitney has stressed on two type of educational research Scientific and Philosophical. The Scientific researches are conducted by experimental method where second type through Philosophical method.

OBJECTIVES OF EDUCATIONAL RESEARCH

The educational -researches are concerned with three goals and educational research activities are oriented to achieve these three Objectives:

1. Theoretical Objectives

This may be referred to the development of theory. The scientific researches may lead to the establishment of new edifice of knowledge or thoughts. The theoretical research always has implications for future action and should allow the prediction of natural phenomenon. In educational, theoretical bases are given for practice. Theory of education deals with entire framework of Education. Theoretical expansion is essential in the field of education.

2. Factual Objectives

A second objective of educational research is to find out-new facts or the accommodation of new facts. This serves descriptive function. An investigator usually concerns with the objective together specific information through surveys or historical studies. The problems of this nature can be solved by scientific enquiry.

3. Practical Objectives

When a theory is applied in a action, it is termed as practical purpose. The third objective is to solve a practical problem, which is of immediate concern with an investigator. The purpose is to improve and modify the practice. The applied research and action research focus the attention towards the practical aspects. This objective may be achieved individually or collectively but the purpose is the improvement of current practices. The result of such investigations does not contribute in the fund of knowledge. These are usually personal projects to bring excellence in their own job. The problems may be solved by scientific procedure but critical thinking or trial error procedure may solve some problems.

TYPE OF EDUCATION RESEARCH

The first two objectives of educational research contribute new knowledge in the form of new theory and facts in a particular field studied. The third objectives do not contribute in knowledge but suggests new application for piratical problems. Thus, the educational researches are classified broadly into two categories:

1. **Fundamental of Basic Research.**
2. **Action Research or Applied Research.**

MEANING AND DEFINITION OF ACTION RESEARCH

The concept of acting research is very old but Stephen M. Corey has applied this concept first time in the field of education. He has defined the term 'Action Research': "The process by which practitioners attempt to study their problems scientifically in order to guide, correct and evaluated their decision and. actions, a number of people have called Action Research".

According to Corey: "Action research is a process for studying problem by part-owners scientifically to take decision for improving their current practices."

"Research concerned with school problems carried on by school personal to improve school practice is action research."

– S. Backwell

According to McTherte:

"Action Research is organized, investigative activity, aimed toward the study and constructive change of given endeavor by individual or group concerned with change and improvement." On the basis of these definitions, the following characteristics may be enumerated of Action Research:

1. It is a process for studying practical problems of education.
2. It is a scientific procedure for finding out a practical solution current problems.
3. The practitioner can only study his problems.
4. The faces is to improve arid modify the current practices.
5. The individual and group problem is studied by action research.
6. It does not contribute in the fund of knowledge.
7. It is personal research.

ORIGIN OF ACTION RESEARCH

The concept of action research is based upon the modern Human Organization Theory'. This organization theory is task and relationship centred. It assumes that workers of the organization have the capacity to solve the problems and take decision. He brings certain values, interests and attitudes in the organization. Therefore, the opportunities should be given to the workers of the organization to study and solve the current problems of their practice so that they can improve and modify their practices. The effectiveness of an organization depends upon the abilities and skills of the workers. They have to encounter some problems and can realize the gravity of the problems. The practitioner can only study and, solve the problems of the current practice. The workers will be efficient when they will be given freedom for improving and modifying their practices.

The origin of action research is also considered from the field of psychology or social psychology. Kurt-Lewin explains life space in terms of person and goal. There is a barrier in between person and goal. He has to over come the barrier to achieve the goal. It depends upon the abilities of a person to achieve the goal. The person's activities are governed by the goal the practitioner has to face this type of situation.

The concept of action research is being used in education since 1926. Backingham has mentioned this concept first time in his book 'Research for Teachers'. But **Stephen M. Corey** has used this concept for solving these problems of education first time.

STEPS OF 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 process. The following are the six steps of research process:

1. **Selection of problem.**
2. **Formulation of Hypotheses.**
3. **Design of research (Sampling and methodology).**
4. **Collection of Data (Administration of tool and scoring).**
5. **Analysis of data (Use of statistics).**
6. **Formulation of conclusions.**

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

Second Step : Some active solutions are given for the problem. When these solutions are based on certain rationale they are termed as hypotheses.

Third Step : Therefore, in this step hypotheses are formulated techniques of research. The appropriate method and techniques are selected for this purpose.

Fourth step : The research tools are administered on the sample subjects and their responses are scored out. Thus, the obtained date is organized in tabular form.

Fifth Step : The appropriate statistical techniques are used to analyze the data so that some decision may be taken about the hypotheses. The result is used to draw some conclusions.

Sixth Step : The result is discussed and some conclusions for the practical problems.

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

DIFFERENCE BETWEEN FUNDAMENTAL RESEARCH AND ACTION RESEARCH

Objective of Action Research

1. **Purpose:** The improvement in school and classroom teaching process.
2. **Investigator:** The person in the Job, Teacher, Principal, Inspector, and Administrator. Investigator must be directly associated with the problem. There are no pre-requisites of academic qualification.

3. **Problem:** The form of the problem is very narrow. It is a local problem. It is practical problem. The problem is selected and finalized by the worker.

Objectives Fundamental Research

1. **Contributes of new knowledge in the form of new theory facts and truth:** The investigator should have postgraduate degree in the subject. He should have specialization in the field. He may be or not related with the problem.
2. **The problem is broad and relates to the broad field of education:** The problem may be universal by the research but the external experts approve it. Investigator himself. No external approval is required.
3. **Hypotheses:** The action hypotheses are formulated on the basis of the causes of the problem. An action hypothesis needs one design of research. One hypothesis is tested at a time.
4. **Design:** The design of action research inflexible. It can be changed according to the convenience of the worker. It includes certain steps and measuring tools.
5. **Sampling:** There is no problem of sampling in action research, accidental or incidental sample is used. The students of a class or school are the sample of action research. No parametric techniques are used.
6. **Data Collection:** Observation and teacher made tests are used for collecting data in action research. The standardized too may be used if it is available
7. **Analysis of Data**: The data are analyzed by using statistical techniques to draw some result.
8. **Simple statistics:** percentage, mean, mode, Sd. and graphical .The hypotheses are formulated on the basis of some rationale. All the hypotheses are tested by one design of research. The hypotheses are not essential in all types of research. The design is rigid and it cannot be changed. Theoretical and practical knowledge is essential for the researcher. It involves, method, sample and techniques of research. It is the basis of research and major problem of sampling the knowledge and training of sampling techniques are essential; usually probability-sampling techniques are employed. The true representative sample is selected by using appropriate techniques of sampling from the population.

   Usually the standardized tests are used for collection of data in basic research. If such type of tools is not available, the investigator has to prepare the tools and its reliability and validity are estimated.

   The parametric statistical techniques are used for analyzing the data. The knowledge and understanding are essential. The decision is taken about representation are employed for this purpose. The decision is taken about solution of the problem.
9. **Conclusion:** Some conclusions are drawn about the solution of the problem the conclusions are in the form of remedial measures for improving the current practices. It does not contribute in the fund of knowledge.
10. **Evaluation:** An Action research project is evaluated by, the investigator himself and external evaluation is not required. Its results are in the form of improvement in the job and current practices.
11. **Finances:** Finances for the action research are met out by the school or investigator himself. The extension departments of NCERT are also financing such project.
12. **Training:** The teachers are trained in B.Ed. programmes for the knowledge and skill of action research concept. The extension department is organizing workshops for action research

projects for in-service teachers. The conclusions are in the form of generalization. The generalization may be a new theory, new interpretation. Thus the conclusions may be the new knowledge the field studied, a panel of examiners is appointed for examining the report of fundamental research; it may be approved, revised or rejected. The degree of Ph. D.D. Sc. or D. Phil is awarded for the worth contribution in the field studied.

The, V.G.C. is awarding junior research and senior research fellowship for fundamental research in all the subjects. The NCERT is financing research project of education. The V.G.C. is also giving financial assistance to college teachers for their research work. An investigator bears the expense himself.

This is a compulsory paper of Research Method and Statistics at M. Ed and M. Phil level for the knowledge and understanding of research methodology. During these programmes, the students have submited a dissertation for the practical knowledge of conducting research work. The field for basic research is broad. It deals with the basic problems of educating and teaching learning situations.

13. **Scope:** The field of action research work is very narrow. It deals with the problems of classroom teaching and school. The field is local.
14. **Examples:** The problem of assignment, spellings, pronunciation and poor attendance. The enrollment of school is reducing rapidly is the major problem of action research in the field of education.
15. **Importance:** The major importance for solving the local problems of school and classroom teaching.
    - **(*a*) Teaching skills for different subject teachers (languages, social studies, and sciences).**
    - **(*b*) Behaviour pattern of effective teachers and creative teacher.**
    - **(*c*) Difference between trained and untrained teachers' performance.**
    - **(*d*) The major importance is to answer the basic questions and contribute field of knowledge by solving the basic problems of education.**

1. 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 of teachers and principles of studying their problems.
3. To develop the democratic 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 for learning.

2. Analysis the Causes of the Problem: The causes of the problem are analyzed with the help of some relevance. The nature of the causes is also analyzed whether it is under the control or beyond the control of investigator. This helps in formulating the action hypotheses.

3. Formulating the Action Hypotheses: The basis for the formulation of action hypotheses is the causes of the problem, which are under the approach of an investigator. The studies action hypotheses consist of the two aspects: action and goal. It indicates that the action should be taken for achieving the goal.

4. Design for Testing the Action. Hypotheses: The design is developed for testing the most important action of hypotheses. Some actions may be taken and their results are observed. If the hypotheses are not accepted, second design is developed for testing another hypothesis. In action research on hypotheses is tested at a time. The design of action research is flexible and can be designed at any time according to the convenience of the researcher.

5. Conclusion of Action Research Project: The accepting or rejecting action hypotheses leads to draw some conclusions. The statements conclusion indicates some prescription for the practical problem of school or classroom. The conclusions are useful in modifying and improving the current practices of school and classroom teaching.

National Council of Educational Research and Training has been taken interest in the action research projects. The extension department of NCERT has been conducting seminar and workshops for in-service teachers for imparting knowledge and skill and action research projects. It has developed its own paradigm of action research projects.

A PARADIGM OF ACTION RESEARCH PROJECT

The steps and sub-steps are proposed by NCERT for conducting action research project:

1. Topic of the project.
2. Objectives of the project.
3. The system of the project work.
4. Evaluation of the project.
5. Estimate of expenditure for the project.
6. Name of the instruction number of students enrolled with sections.
7. Number of teachers in different subjects.
8. The available facilities in school for the project work.
   - (*a*) Background for the project work.
   - (*b*) The importance of the project for the school.
   - (*c*) Identification of problem.
   - (*d*) Defining and delimiting the problem.
   - (*e*) Formulation of action hypotheses.
   - (*f*) Testing the action Hypotheses.
   - (*g*) Conclusions of the project work.
   - (*h*) Remark by an investigator.

On the lines the teacher plans an experimental project after conducting the experiment, he writes a reports of the project work.

EXPERIMENTAL PROJECT OF ACTION RESEARCH

1. **Topic of the Project:** The geography students are not using maps and atlas in school.
2. **The Investigator:** An experience geography teacher.
3. **The Background for the Project Work:** During the last years, it has been observed that students are not using maps and atlas in their geography classes. The concepts of geography are not clear to the students.

4. **Objectives of Project work:** This project is taken for achieving the following objectives:
   (*a*) To develop the interest in using the maps atlas in geography class.
   (*b*) To develop understanding about the use of maps and atlas in geography study.
   (*c*) To develop the feelings among the students that geography content can be best understood by the use of maps and atlas.
   (*d*) To raise the level of performance in geography.
5. **Importance of the Project for the School:** The study of geography is very essential and useful for .the students. It provides the general knowledge about the human phenomenon. The standard of geography may be raised and it may attract student for admission. The result of geography examination may be upgraded.
6. **Field of the problem:** The problem concerns with the classroom- teaching. It will promote leading aspect of management learning the field of problem is the proper use of teaching aids in geography.
7. **The Specification of the Problem:** The problem is located in Govt. Inter College, Chitrakoot, Dist. Banda, U.P., Class VIII B Period VI Subject geography. The students of the class are not using maps and atlas in geography subject.
8. **Analysis of the Problem:** The causes of the problem may be analyzed with the help of the following table:

Sl.No .	*Causes*	*Evidences*	*Nature*	*Solution*
1.	The teachers do not stress on the use map and atlas.	Teacher experience and observation	Fact	Control
2.	The geography maps are not available in the entries.	No geography room and stock book entire	Fact	Under control of the teacher
3.	Most of the students do not have the atlas	Enquiring from the students	Fact	Beyond the control of teacher.
4.	The geography teacher is not using maps in their teaching.	Student's opinion and teacher observation and experience.	Fact	Under the approach of teacher

9. **Formulation or Action Hypotheses:** The action hypotheses are formulated for the problem. Generally the causes, which are under the approach of the teacher, are considered for this purpose. The following two important action hypotheses are developed.
   First Action Hypotheses: The tendency of using maps and atlas is promoted by giving the adequate stress on the use of maps and atlas in geography teaching. The first part is the later part is action to be taken for Promoting interest in using maps and atlas.
   Second Action Hypotheses: using the proper teaching aids in teaching geography class may develop the interest of using, maps and atlas.
10. **Design for Testing Action Hypotheses:** The action hypotheses are tested separately by employing different designs. A design has been given for testing the first action hypotheses.

The Design for First Action Hypotheses

	Initiation of Activities	*Techniques*	*Source*	*Time*
1.	A list is prepared of students who have the atlas.	Enquiring from the geography student during teaching period	Teacher provide a atlas name	Four days
2.	The students who do not have the atlas will be asked to purchase it.	Teacher will enquire from students	Teacher will locate the poor students.	Three days
3.	The atlas may be given to poor students from the Book Bank	He will send this test of information to parents also.	He will request the principal for purchasing more copies of atlas from Book Bank	Three days
4.	During geography class teacher will regularly ask the students to bring and use atlas.	The Teacher will supervise the use of atlas by students	He will note the two names of these students who do not purchase atlas	Two weeks

The Data collected by observation and maintaining record of students, who have used the atlas. An achievement test may be and interned to measure their level performance. These evidences show the improvement in the teaching practices, and then the conclusion may be grown. If the evidences do not show significant improvement in the problem.

The Design for Second Hypotheses

Initiation of Activities	*Techniques*	*Source*	*Time*
1. The teacher will provide the awareness about the available maps in the school.	1. From the record and availability of maps in geography room.	1. Teacher will contact to the in change the geography room	Two days
2. The teacher will arrange the required maps in teaching geography.	2. The teacher will review course and content prescribed for Glass VIII in geography subject.	2. The teacher will request the principal and contact nearby extension service centers.	Four days
3. He will select related maps for the content of geography.	3. The teacher will consider the content of his lesson.	3. He can borrow from geography room in charge.	Three weeks
4. He will use proper maps; charts and models in his teaching.	4. The lesson will be developed with the help of teaching aids.	4. Teacher will locate the poor students.	Three Weeks (The teacher will arrange the maps himself with three weeks and the students are asked to bring required maps in geography period.)
5. He will ask the students to enter the required places after his presentation	5. Teacher will show these places on map and will supervise the students map work.	5. Teacher will locate the poor students.	Three weeks

In implementing the design, the data is gathered by observation, student's reactions and achievement test of geography may be administered. The decision may be taken regarding the action hypotheses.

11. Evaluation: The criterion of evaluating the action research project is the workability of the action hypotheses. Using observation technique, attitude scale, interest inventory, opinion reactions and scores on achievement test collects the data. The obtained data may be presented graphically to show the rate of development and data is analyzed by calculating percentage and other appropriate statistical techniques. Some conclusions' may be drawn on the basis of statistical analysis.

12. Comments of the Investigator: The investigator will draw some conclusions about the workability of action hypotheses. This may provide some basis for suggesting prescription or remedy for solving the problem. The use of maps and atlas is very essential for teacher as well as students to understand the concepts of geography.

SUGGESTIONS FOR ACTION RESEARCH PROJECT

In developing an action research project the following suggestions should be kept in view:

1. The nature of the project should be decided whether it is developmental project or experimental project.
2. An investigator must be directly associated with the problem to be studied.
3. The form of problem should be real.
4. The project should be so planned that it should not intervene the function of schoolwork.
5. The project should be concerned directly with qualitative improvement and level of performance of the students.
6. The project should be evaluated objectively by employing reliable and valid tools.
7. The action hypotheses should be formulated by considering the causes of the problem, which are under the approach of the teacher or worker.
8. The design of Action Research project should be economical from money, time and energy point over view.
11. The problem should be selected objectively and studied scientifically.
12. The causes of the problem should be isolated objectively on the basis of some evidences.

EXERCISES

1. Define the term 'Research' and give the meaning of Educational Research.
2. Differentiate between Action Research and Fundamental Research or Basic Research.
3. Explain the concept of 'Action Research' and discuss its importance for the teacher.
4. Select one problem and prepare an Action Research project of the same.

Chapter 18

Presentation of Statistical Data

MEANING OF THE TERM STATISTICS

Usually word statistics carries the following three common meanings:

1. In first place, it refers to numerical facts. State as well as Central, Statistical department and various other agencies can be seen engaged in collecting valuable statistics (numerical facts concerning the birth and death, school attendance, employment market, output of Industrial plants and Agriculture fields etc.
2. As a second meaning, word statistics refers. to the method or methods of dealing with numerical facts. In this sense, statistics is taken as science of collecting, classifying, summarizing, analysing and, interpreting of numerical facts.
3. In its third meaning, statistics refers to the summarized figures of numerical facts such as percentage, averages, means, medians, modes, standard deviations etc. Each of these figures separately, (average or mean etc.) is referred to as 'Statistics' .

In this way, the word statistics can be referred to numerical facts or science or methodology of dealing with numerical facts or summarized figures of numerical facts. Tate has beautifully summarized these different-meanings of the word statistics in the following witty comments, "It's all perfectly clear; you compute statistics (mean, median, mode etc.) from statistics (numerical facts) by statistics (statistics as a science or methodology)" (1955, p. 5)

THE MEANING OF TERM DATA

The dictionary meaning of the word data is facts (plural of datum, meaning fact). Thus, in wider sense the term data designates the evidence or facts for describing a group or a situation, but in a particular sense it is generally used for numerical facts such as heights, weights, scores on achievement tests and intelligence test, etc.

METHODS OF ORGANISING AND PRESENTING DATA

The data from tests and experiments in the form of scores need to be classified and organised in a systematic way fro understanding the meaning and deriving some useful conclusions, in general the following four methods are used for organizing and presenting statistical data:

A. Presentation in the form of Statistical Tables.
B. Presentation in the form of Frequency distribution.
C. Graphical presentation of ungrouped data.
D. Graphical presentation of Frequency distribution (Grouped data).

A. Statistical Tables

In this form of presentation, data are tabulated or arranged in some properly selected classes and the arrangement is described by title and sub-titles. Such tables can list the original raw scores as well as the percentages, means, standard deviations etc. Below we give a sketch of a table for illustration.

Table 18.1

Pass Percentage of High Schools of Rohtak City in the High School Public Examination

High School of Rohtak	*Name of School*	*Pass percentage*	*Girls Pass percentage*	*Boys Pass percentage*
	A			
	B			
	C			
	D			
	E			

The Frequency Distribution

In this form of presentation, we group the quantitative data into some arbitrarily chosen classes. For this purpose, usually, the scores are distributed into groups of scores (classes) and each score is allotted a place in the respective group or class. It is also, seen how many: times a particular score or group of scores occurs in the given data. This is known as the frequency of a score or group of scores. In this way, Frequency distribution may be considered as a method of presenting a collection of groups of scores in such a way as to show the frequency in each group of scores or class. Various steps for presenting quantitative data by a frequency distribution can be understood properly with the help of the following example-

Example–The marks obtained by 50 students in an Achievement test are given below:

62, 21, 26, 32, 56, 36, 37, 39, 53, 40, 54, 42
44, 61, 68, 28, 33, 56, 57, 37, 52, 39, 40, 54
43, 43, 63, 30, 34, 58, 35, 38, 50, 38, 52, 41
51, 44, 41, 42, 43, 45, 46, 45, 47, 48, 49, 45
46, 48.

Tabulate these scores in Frequency distribution by clearly explaining the various steps involved.

Steps for Grouping Data into Frequency Distribution

1. **Finding the range–** First of all the range of the series to be grouped is found out. It is done by subtracting the lowest score from the highest. In this present problem the range of the distribution is 68–21 i.e. 47.
2. **To determine the class interval or grouping interval–**After finding out the range, the number and size of the classes or groups to be used in grouping the data are decided.

There exists two different for this purpose.

First Rule–For gaining an idea of the size of the classes i.e. Class interval, the range is divided by the number of classes desired. Class interval is usually denoted by the symbol "*i*" and is always a whole number. Thus the formula for deciding the class interval is

Now the question arises in how many classes or groups one should distribute a given data. As a general rule Tate writes, "If the series contains fewer than about 50 items, more than about 10 classes are not justified. If the series contains from about 50 to 100 items. 10 to 15 classes tend to be appropriate; if more than 100 items; 15 or more classes tend to be appropriate. Ordinarily not fewer than 10 classes or more than 20 are used." (1955, p. 44).

If by dividing Range by number of classes we do not get whole number, the nearest, appropriate number is taken as class interval.

Second Rule–According to second rule class interval (*i*) is first decided and then the number of the classes is determined. For this purpose, usually, the class intervals of 2,3,5 or 10 units in length are used.

Both of the above mentioned rules are practised. In our opinion, it is better to use a combined procedure made out of both the rules. Actually the range, the number of classes and the class interval-all should be taken into consideration while planning for a, frequency distribution and we must aim to select a proper class interval (*i*) that can yield, appropriate categories (number of classes) as mentioned above by Tate.

Considering in this way, proper interval (*i*) in the present example is 5.

[Here Range = 47. Scores are 50 in number and thus about 10 classes are sufficient. Therefore i = 47/10 = 47 i.e. Nearest whole number = 5]

3. **Writing the Content of Frequency Distribution–**After deciding the size and number of the class interval and locating the highest and lowest scores of the given data, we proceed to write down the content of the Frequency distribution. For this purpose 3 columns are drawn and work is carried out as under.

   (*a*) *Writing the classes of distribution*–In the first column, we write down all the classes of distribution. For this purpose first of all the lowest class is settled down and afterwards other subsequent classes are written down. In the present problem 20-24 can be taken as the lowest class and then we can have classes as 25-29, 20-34 etc. Upto 65-69.

   (*b*) *Tallying the Scores into proper classes*–Under this step, the scores given in the data are taken one by one and tallied in their proper classes as shown in the 2nd column of the table given below. These tally marks against each class are then counted. These counted numbers are respectively called the frequencies of that class. These are written in the third column as shown below:

Table 18.2

Class of Scores	*Tallies*	*Frequency*
65–69		1
69–64		2
55–59		4
50–54		7
45–49		9
40–44		11
35–39		8
30–34		4
25–29		2
20–24		1
	Total Frequencies (N)	50

(*c*) *Checking the tallies* – The total or 3rd column should be equal to the number of individuals whose scores have been tabulated. Under the above the tabulation total of frequencies Le. 50 agrees with the total number of students given in the problem.

Some More things to be known Regarding a Frequency Distribution

1. *Class limits of the frequency distribution* – The designation of classes i.e. 20~24, 25-29, 30-34 etc. are called the indicated or written class limits. The actual class limits are always taken as 0.5 units below and 0.5 units above the written class limits. For example the actual limit of class 20-24 is 19.5-24.5 (19.5 as lower and 24.5 as higher class limits).
2. *The mid-point of a class in a frequency distribution* – In a frequency distribution classes are sometimes indicated by their mid-values or mid-points. The formula of determining the mid-point of a class is–

$$\text{Mid-point of a class} = \text{Indicated or written lower limit} + [(\text{upper limit} - \text{lower limit})/2]$$

[**Note**. We don't consider actual class limits in calculating mid-point. Thus of the class 20-24 the mid-point is 20+[24–20/2] =20+2 =20]

The Graphical Presentation of Ungrouped Data

For the data which is not grouped into a frequency distribution we use the following common graphs or diagrams.

(*i*) Pictographs or Pictograms.
(*ii*) Bargraphs on Bar Diagrams.
(*iii*) Circle or pie graphs/diagrams.
(*iv*) Line graphs.

Let us have an idea of all these four types of graphical representation.

Pictographs or Pictograms

Pictographs or pictograms are the graphs or diagrams used for presenting an ungrouped statistical data in pectoral (picture like) form: A picture is said to be worth more than 100 words spoken or written. Thereby the pictorial representation of the data is always considered better than its description in the words and figures. Let us illustrate this fact through an example.

Example 18.1: In a data collection process it was found that there are 100 students in class VI; 85 students in Class VII, 80 Students in VIII, 90 Students in IX and 70 Student in X. Present this data first into a tabular form and then in pectoral form.

Solution

Presentation of data in a Tabular Form

Class	*VI*	*VII*	*VIII*	*IX*	*X*
Number of Students	100	85	80	90	70

Presentation of Data in the pictorial form

Step 1 : Let us decide to represent a student with a picture (indicative of a student figure)

Step 2 : For the sake of brevity and simplicity let us have a scale, a picture (of student) equal to 20 students in number.

Following these steps the pictorial presentation (pictograph) of the given data will be as under–

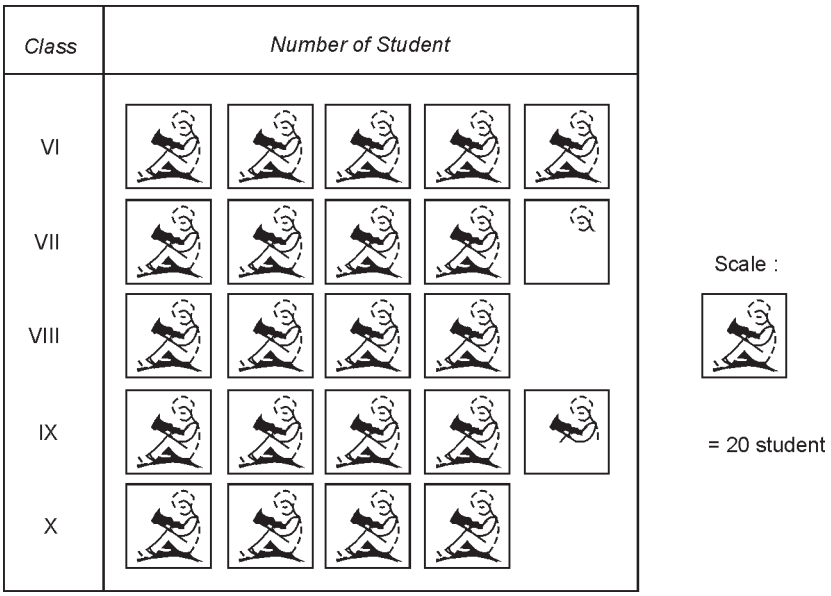


Fig. 18.1

Example 18.2: On a parking place at new Delhi Railway Station the following statistical data (about the number of cars from different states) was collected and arranged in tabular form. Make a pictogram of this tabular data.

State	*Number of Cars*
Delhi	140
Uttar Pradesh	60
Punjab	30
Haryana	100
Others	70

Fig. 18.2

The pictograph showing the number of cars belonging to different states is presented below:

State	*Numbers of Cars*
Delhi	
Uttar Pradesh	
Punjab	
Haryana	
Other states	

Each stands for 20 cars.

Fig. 18.3

You can now very well imagine the merits and advantage of a pictograph. A mere glimpse of the pictograph reveal that there were maximum number of a cars parked at the Railway Station from Delhi State.

It was followed by Haryana and other states. The minimum number of cars parked were from Punjab and in this way valuable statistical information maybe easily gathered in an interesting and pleasing way from a pictograph.

However, there lies some difficulties in the pictorial presentation of data especially in choosing a suitable scale (picture for a given number of units) and its comprehension. In the above two examples we have chosen figure of student and a car representing strength 20. In both these pictograph we may easily notice the difficulties encountered in representing the numbers not wholly divisible by 20 i.e. 30, 50, 70, 85, 90 etc. We have represented the strength of 85 (in the first example) students with four complete pictures and fraction (only head). Similarly in the case with the incomplete pictures of cars. Here we just have approximation and not the exact measurement of the pictorial figures for representing the scaled fractions numerical data. This difficulty can be somewhat removed in other forms of graphical representation of data as will be noticed soon.

Bar Graphs or Bar Diagrams

In stead of using pictures we can: use bars (rectangles of similar breadth) for the representation of numerical data. this mode of presentation of statistical data through bars is known as bargraphs or bar diagrams. As example let us try to have a bar graph of the tabulated data given in example 18.1. It may take the following shape given in the Fig. 18.3 .

How to draw bar graph?

(*i*) Try to use a graph paper for drawing the bar graph.

(*ii*) On one of the axes X or Y try to plot numerical data by choosing a proper scale and have the other variable like classes in this example on the other axis. Here in this example the numerical strength of students has been plotted on the *y*-axis. Here the number of students in the different classes are thus represented by the bars (rectangles of similar breadth) constructed all, the X-axis.

What can be Inferred from the Bar Graph?

A bar graph just shown above may provide the following information in a quite simple and quick way.

It shows the strength of students in a particular class of the school i.e. there are 70 students in class X.

- The class having highest strength i.e. class VI.
- The class having lowest strength i.e. class X.
- It also reveals that the strength of students gets decreased as we pass through the classes VI to VIII. It once again gets increased in class IX but soon lowers down again in class X.
- The relative strengths of the students studying in different classes of the school may also be adjudged easily for one or the other type of comparisons.

Example 18.3: Let us have another bar graph for further illustration. Can you think about various types of information revealed to you just through its glimpse and useful interpretation?

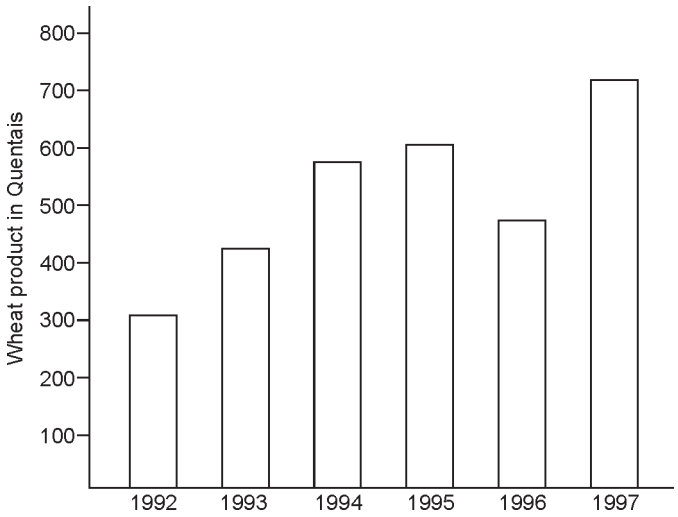


Fig. 18.4 Bar graph showing Wheat production during different years.

We think you can easily infer from the above bargraph that the years of the highest and the lowest yields are 1997 and 1992 respectively and in comparison to the yield of the year 1992. There is approximately double production in the year 1995.

Circle graph or Pie diagrams

Circle or pie graphs/diagrams provide us an opportunity to represent statistical data through the figure or a circle and its constituents Le. proportionate sub-divisions. These are specifically helpful in the case for which the question of proportion is of much interest. To construct them requires a working knowledge of angle measurement and percentages.

The process of the construction of a pie graph may be understood with the help of an example given below.

Example 18.4: 200 B.Ed. Students of a College of Education were asked to give their options for the participation in one or the other types of co-curricular activities. The preferences data was tabulated as under–

Activities	Debate	Dance	Music	Painting	Models	Excursion
Number of students	42	36	36	12	6	68

Present this data through a pie diagram.

Solution: The steps for the construction of the required pie diagram may be outlined as below-

(*i*) A circle has the value of 2π (2 pie) i.e. 3600. In the present example the total sample is 200 which has to be represented through a complete circle having 3600.

(*ii*) The various constituents of the collected data i.e. preferences for the one or the other co-curricular activities then may be assigned by varying values of pie in terms of the degrees as computed below-

Debate: Number of students = 42 out of 200

Proportion out of 200 = 21%

$$\text{Proportion out of } 360° = \frac{42}{200} \times 360° = 75.6\%$$

Dances and Music: No. of Students = 3 6 out of 200

$$\text{Proportion out of } 200 = \frac{36}{200} \times 200 = 18\%$$

$$\text{Proportion out of } 360° = \frac{36}{200} \times 360° = 64.8\%$$

Painting: No. of Students = 12 out of 200

$$\text{Proportion out of } 200 = \frac{12}{200} \times 100 = 6\%$$

$$\text{Proportion out of } 360° = \frac{12}{200} \times 360° = 21\%$$

Modeling: No. of students 6 out of 200

$$\text{Proportion out of } 200 = \frac{6}{200} \times 100 = 3\%$$

$$\text{Proportion out of } 360° = \frac{6}{200} \times 360° = 10.8\%$$

Excursion: No. of Students = 68 out of 200

$$\text{Proportion out of } 200 = \frac{68}{200} \times 100 = 34\%$$

$$\text{Proportion out of } 360° = \frac{68}{200} \times 360° = 122.4\%$$

(*iii*) Now all these above proportions 75.6°, 64.8°, 64.8°, 21.6°, 10.8° and 122.4° may be represented as the different sectors of a whole circle with the help of the knowledge concerning measurement of angels.

(*iv*) These may take the final following form for making the required pie diagram.

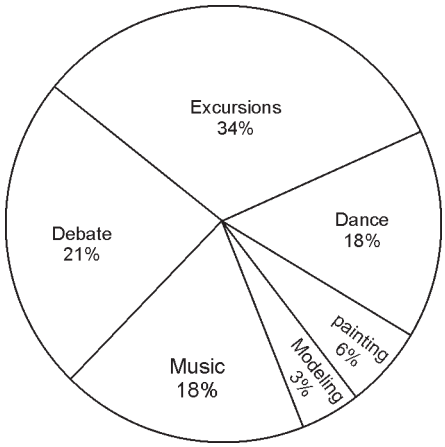


Fig. 18.5 Pie graph showing preferences of B.Ed showing for the co-curricular activities.

Example 18.5: A researcher collected the data from the 100 people fond of pets and tabulated the findings as under:

	Cats	Dogs	Snakes	Turtles	Fish	Parrots	Other birds
No. of People	180	320	50	50	90	180	130

Represent the above data through a pictograph.

Solution: Following the procedure suggested in examples diagram may take the following shape.

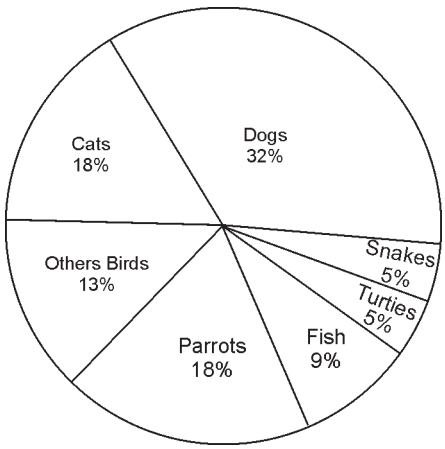


Fig. 18.6 Pie graph showing people fond of different pets.

Line Graphs

Line graphs can be better used in describing the Con-committed relationships between two variables by plotting their respective values on the *x* and *y* axes of a graph paper (After choosing appropriate scales). Let us illustrate this fact through examples.

Example 18.6: Science students of the IX class of a school collected data about weather on a cold day of the month December by recording the room temperature at various hours of the day and obtained the following line graph of the results of their survey.

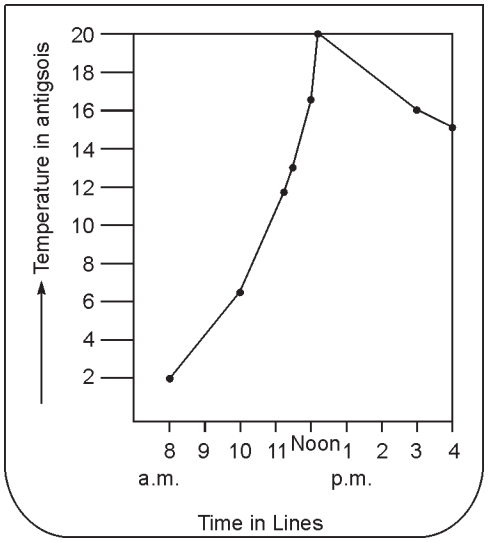


Fig. 18.7 A line group showing the temperature on a December day.

Process of Construction

(*i*) Here time in house has been plotted on X-axis and the corresponding temperature in centigrade have been plotted on y-axis.

(*ii*) The five small squares of the graph paper have been taken equivalent to 1 hour on X-axis and 2 centigrade on Y-axis.

(*iii*) The facts like 2°C was recorded at 8.00 a.m 0.6ºC was recorded at 10.00 a.m. etc. have been plotted as the varying points and then these points have been joined by continuous straight lines (see the placing of the points P, Q, Q, S, T, U, W as the intersection points of paired data and their joining).

What can be inferred from the line graph?

Line graphs like above can reveal many facts and information about the collected data and consequently we may be able to get answers of the queries like below-

1. For which hours during the day did the students collect data?
2. What was the high temperature of the day according to the graph?
3. Between what hours was the temperature increasing? Decreasing?
4. About what time in the morning was the temperature about 10ºC?
5. What do you predict the temperature might be at 5.00 p.m. lower than or higher than 16°C?

Example 18.7: The line graph given below in Fig. 15.8 depicts mastery of multiplication facts by a particular student in the course of learning. Here the time spent in weeks for having mastery over the

multiplication facts is shown on X-axis and the achievement in terms of mastery (known through the percentage of facts mastered) is shown on Y-axis by choosing appropriate scales.

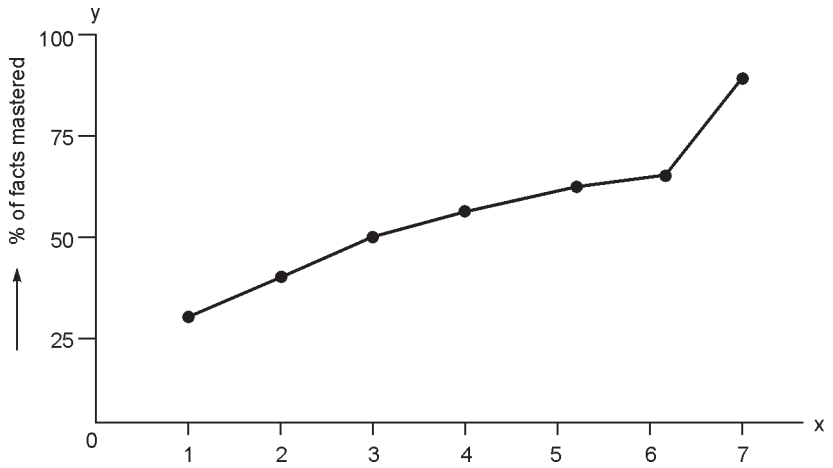


Fig 18.8 Line graph showing progress about mastery over the multiplication facts

Conclusion about choosing a particular graphical mode for the representation of ungrouped data

Each of the graphical mode, pictograph, pie graph and line graph, described above have their own merits and limitations of being utilised in the representation of a given ungrouped data at a particular occasion to furnish useful information. Therefore, a wise decision should always be made before the employment of a particular graphic mode in a particular situation. Take the last example of representing the data concerning mastery over the multiplication by a line graph. Here it would make no I sense whatever to turn these weekly mastery figures into a pie or bar chart. There is also no possibility of representing these through pictograph. Similarly in the case of I representing facts concerning the percentage of pets, there will be no sense in displaying them through a line graph. Here the decision for representing them through a pie graph seems quite appropriate as there stands a whole of which the different figures concerning pets choices are collectively a part.. Contrarily in the case, showing concommitant changes occurred in a one variable, relation to the changes introduced in the other, it is always advisable to use line graph as the mode of representation. In this way, while trying to determine how to best display the particular data one must decide whether to graph the data, and if so, what kind of graph to use.

A. THE GRAPHICAL PRESENTATION OF FREQUENCY DISTRIBUTION (GROUPED DATA)

There are four methods of representing a frequency distribution graphically:

1. The Histogram or column diagram
2. The Frequency Polygon.
3. The Cumulative Frequency Graph.
4. The Cumulative Frequency Percentage Curve or Ogive.

Out of these methods we would take up the most common ones namely the Histogram and the

Frequency Polygon for discussion in the following below:

1. **The Histogram–**A histogram or column diagram is essentially a bar graph of a frequency distribution. The following points are to be kept in mind while constructing the histogram for a frequency distribution.
   (*i*) The scores in the form of actual. class limits as 19.5-24.5,24.5-29.5 etc. are taken in the construction of a histogram.
   (*ii*) It is Customary to take two extra intervals (classes) one below and other above the given grouped intervals or classes (with zero frequency). In the case of frequency distribution given in Table 18.2, we can take 14.5-19.5 and 69.5-74.5 as the two required extra-intervals.
   (*iii*) Now we take the actual lower limits of all the class intervals (including the extra-intervals) and try to plot them on X-axis. The lower limit of the lowest intervals (one of the extra intervals is taken at the intersecting point of X-axis and Y-axis.)
   (*iv*) Frequencies of the distribution are plotted on Y-axis.
   (*v*) Each class or interval with its specific frequency is represented by a separate rectangle. The base of each rectangle is the width of the interval (i) and the height is the respective frequency of that class or interval.
   (*vi*) It is not essential to project the sides of the rectangles down to the base line.
   (*vii*) Care should be taken to select the appropriate units of representation along the X-axis and Y-axis. Both X-axis as well as Y-axis should not be either too short or too long. "A good general rule for this purpose" as suggested by Garrett is to select X and Y units which will make the height of figures approximately 75% of its width. (1971, p. 11).

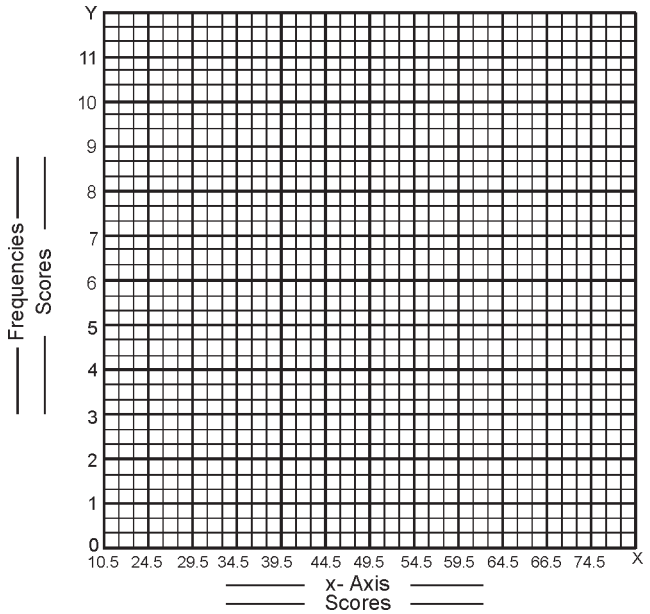


Fig. 18.9 The Histogram of Frequently distribution given in the Table 18.2.

2. **The Frequency Polygon–**A frequency polygon is essentially, a line graph for the graphical representation of the frequency distribution. We can get a frequency polygon from a histogram, if the mid points of the upper bases of the rectangles are connected. But it is not essential a

plot histogram first to draw a frequency polygon. We can construct it directly from a given frequency distribution. The following points are helpful in constructing a frequency polygon

SCALE: ON X-AXIS → 3 SCORES = 5 SMALL SQUARES = 0.5"

ON Y-AXIS → FREQUENCY = 3 SMALL SQUARES = 0.3"

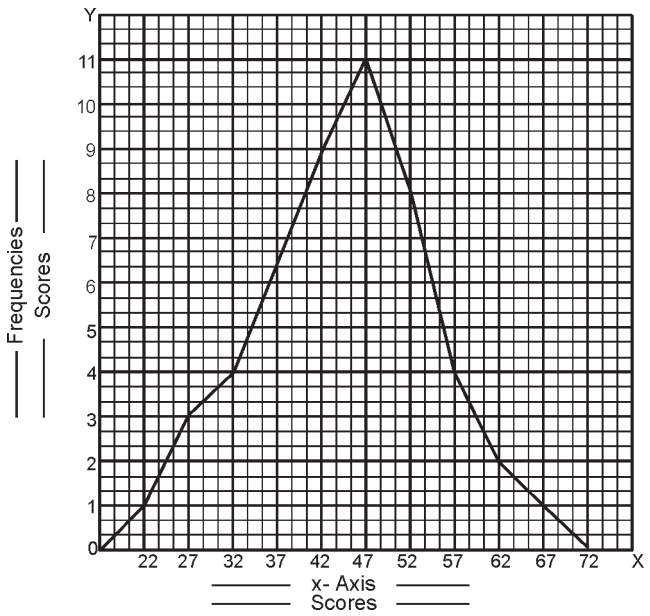


Fig. 18.10 The Frequency Polygon of the Frequency distribution given in Table 18.2

(*i*) Like histogram two extra intervals classes one above and the other below the given intervals are taken.

(*ii*) The mid-points of all the classes or intervals (including two extra intervals) are calculated.

(*iii*) The mid-points are Marked along the X-axis and the corresponding frequencies are plotted along the Y-axis by choosing suitable scales on both axes.

(*iv*) The various points obtained by plotting the mid-points and frequencies are joined by straight line to give the frequency polygon.

(*v*) For the approximate height of the figure and selection of X and Y units the rule emphasized earlier in the case of histogram should be followed.

Comparison Between the Histogram and the Frequency Polygon

Although Histogram and Frequency polygon-both are used for the graphic representation of the frequency distribution and are alike in many aspects yet they posses points of differences. Some of these differences can be cited as below–

1. Where Histogram is essentially the bar graph of the given frequency distribution, the Frequency polygon is a line graph of this distribution.
2. In Frequency polygon we assume frequencies to be concentrated at the mid-points of the class interval. It points out merely the graphical relationship between mid-points and frequencies and thus is unable to show the distribution of frequencies within each class interval. But the Histogram gives a very clear as well as accurate picture of the relative proportions of frequency from interval to interval. A mere glimpse of the figure answers such questions as–

(*i*) Which group of Class-interval has the largest or smallest frequency?

(*ii*) Which pair of groups or class intervals has the same frequency?

(*iii*) Which group has its frequency double that of another?

3. In comparing two or more distributions by plotting two or more graphs on the same axes, Frequency polygon is more useful and practicable than the Histogram as in such cases vertical and horizontal lines in the histogram tend to coincide.
4. In comparison to Histogram, Frequency polygon gives a much better conception of the contour of the distribution. With a part of the polygon curve, it is easy to know the trend of the distribution but a Histogram is unable to tell such a thing.

EXERCISES

1. Discuss in brief the different methods of organising and presenting statistical data.
2. What is Frequency distribution? How can you present a data in the form of a frequency distribution? Illustrate your answers with an example.
3. Tabulate the following 25 scores into a frequency distribution using a appropriate interval-
   72, 75, 77, 67, 72, 81, 68, 65, 86, 73, 67, 82, 67, 70, 76, 70, 83, 71, 63, 72, 72, 61, 67, 84, 69, 64.
4. What is a Histogram? How does it differ from a Frequency polygon?
5. Plot Histogram and frequency polygons separately on the different axes for the following distribution.

(*a*)		(*b*)		(*c*)	
Scores	*f*	*Scores*	*f*	*Scores*	*f*
75–79	1	60–69	1	37–39	2
70–74	3	70–79	2	34–38	4
65–69	5	80–89	3	31–33	6
60–64	8	90–99	4	28–30	10
55–59	11	100–109	7	25–27	12
50–54	18	110–119	12	22–24	7
45–49	10	120–129	8	19–21	7
40–44	8	130–139	5	16–18	3
35–39	6	140–149	3	13–15	2
30–34	3	150–159	3	10–12	1
25–39	1				
20–24	1				
	N = 75		N = 50		

6. Name the different graph or diagrams used for the graphical presentation of ungrouped data. Discuss anyone of them by taking a hypothetical data.

7. What are pictographs or pictograms? Illustrate the procedure of drawing a pictograph with the help of an example.
8. What is a bar graph or bar diagram? Illustrate the procedure of representing ungrouped data through a bar diagram with the help of some hypothetical data.
9. What is a circle or pie diagram? Illustrate the. procedure of representing ungrouped data through a pie diagram with the help of some hypothetical data.
10. Make a pictograph of the following tabular data.

Name of Work Experience	Gardening	Book Binding	Cooking	Clay Modelling	Art and Painting
No. of students opted	60	30	40	45	25

11. The data shown in the given table presents the figure of the merit positions earned in the X and XII classes by a school in different years. Draw a bar graph for representing this data.

Year	1997–98	1998–99	1999–2000	2000–01	2001–02
No. of Merit positions	4	1	24	13	16

12. Draw a line graph for the data presented in the problem 11.
13. Draw a pie diagram for representing the data presented in the problem 10.
14. What is a line graph? How can it be used for representing an ungrouped data? Illustrate the process by taking some hypothetical data.
15. Name the various, methods used for presenting a frequency distribution (grouped data) in a graphical form. Discuss anyone of them in detail.
16. What is a histogram? Illustrate the procedure of drawing histogram for the presentation of a given frequency distribution with the help of an example.
17. What is a frequency polygon? Discuss the procedure of its construction with the help of an example.

Short Answer Type Questions (Answer in 100–120 Words)

1. Explain the meaning of the ‘term’ statistics.
2. What is data? Name the various methods used for the organisation and presentation of data.
3. How can the data be presented through a statistical table? Illustrate with the help of a hypothetical example.
4. What is a frequency distribution?
5. What do you mean by class interval of a frequency distribution? How is it computed? Illustrate with example.
6. What is a pie graph? Explain with the help of hypothetical diagram.
7. What is a bar graph? Explain with the help of hypothetical diagram.
8. What is a histogram?
9. What is a frequency polygon?
10. Distinguish between the histogram and frequency polygon.

Chapter 19

Measurement of Centeral Tendency

If we take the achievement scores of the students of a class and arrange them in a frequency distribution, We can easily find that there are few students who either score very high or very low. The marks of most of the students lie somewhere between the highest and the lowest scores of the whole class. This tendency of a group of a distribution is named as central tendency and the typical score lying between the extremes and shared by most of the students is referred to as a measure of central tendency. In this way, a measure of central tendency as Tate defines, **"is a sort of average or typical value of the items in the series and its function is to summarize the series in terms of this average value" (1955, p. 78).** The most common measures of central tendency are–

(*i*) Arithmetic mean or mean
(*ii*) median and
(*iii*) mode

Each of them, in its own way can be called a: representative of the characteristics of the whole group and thus the performance of the group as a whole can be described by the single value which each of these measures gives. The values of mean, median or mode also' help us in comparing two or more groups or frequency distributions in terms of typical or characteristics performance. In the following pages we will study these measures of central tendency.

ARITHMETIC MEAN (M)

It is the simplest but most useful measure of central tendency. It is nothing but' the 'average' which we compute in our High School Arithmetic and therefore can be easily defined as the sum of all the values of the items in a series divided by the number of items. It is designated by the symbol M.

Computation of Mean in the Case of Ungrouped Data

Let X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10} be the scores obtained by 10 students in an Achievement Test. Then the Arithmetic mean or Mean scores of the group of these students can be calculated as–

$$M = \frac{X_1 + X_2 + X_3 + ... + X_{10}}{10}$$

In this way, the formula for calculating mean of an un grouped data is $M = \frac{\Sigma X}{N}$, where ΣX stands for the sum of the scores or values of the items and N for the total numbers of items is a series of group.

Computation of Mean in the Case of Grouped Data (Data in the Form of Frequency Distribution)

(*i*) In frequency distribution where frequencies are greater than 1, the mean is calculated by the formula $M = \frac{\Sigma FX}{N}$, where *X* represents the mid-point of class interval, *F* its respective frequency and , the total of all the frequencies.

We can illustrate the use of this formula by taking the frequency distribution previously given

Scores	*f*	*Mid-Point*	*(FX)*
65-69	1	67	67
60-64	3	62	186
55-59	4	57	228
50-54	7	52	64
45-49	9	47	423
40-44	11	42	462
35-39	8	37	296
30-34	4	32	128
25-29	2	27	54
20-24	1	22	22
			Sfx = 230

$$M = \frac{\Sigma FX}{N} = \frac{2230}{50} = 446$$

Arithmetic Mean = 44.6

(*iii*) Short cut Method of computing the mean of grouped data

Mean for the grouped data can be computed easily with the help of the following formula:

$$M = A + \frac{\Sigma X}{N} \times i$$

Where A stands for assumed mean, *i* for class interval, *f* for the respective frequency of the mid-value, *N* for the total frequency and *x'* for $\frac{x-a}{i}$ (the quotient obtained after division of the difference between the mid-value of the class and assumed mean by *i*).

The use of this formula can be easily understood through the-following illustration

Let Assumed Mean (A) = 42

Scores	f	x	$x' = \frac{X - A}{i}$	fx'
65–69	1	67	5	5
60–64	3	62	4	12
55–59	4	57	3	12
50–54	7	52	2	14
45–49	9	47	1	9
40 –44	11	44	0	0
35–9	8	37	– 1	– 8
30–34	4	32	– 2	– 8
25–29	2	27	– 3	– 6
20–24	1	22	– 4	– 4
			$\Sigma FX'$ = 26	

$$x' = \frac{\Sigma x'}{N} \times i = 42 + \frac{26}{50} \times 5 = 42 + 2.6 = 44.6$$

MEDIAN (M_d)

If the items of a series are arranged in ascending or descending order of magnitude, the measure or value of the central item in the series is termed the median. In this way, as Bloomers are Lindquist define:

"The Median of a distribution is the point on the score scales below which one-half or 50 percent of the scores fall."

Thus, median is the score or value 'of the central item which divides the series into two equal parts. In this connection it should be clearly understood that central item itself is not the median. It is only the measure or value of the central item that is known as median. For example, if we arrange in ascending or descending order the marks of 5 students, then the marks obtained by 3rd student from either side will be termed as the median of the scores of the group of students under consideration.

Computation in the Case of Ungrouped Data

There may arise two situations–

(*i*) *When N (the number of items in series) is odd* – In the case where N i.e. number of students in the above example, is odd (not divisible by 2) then the median can be computed by the formula.

M_d = The measure of value of the $(N + 1)/2$th item.

Example–Let the scores obtained by 7 students in an Achievement Test be 17, 47, 15, 35, 25, 29, 39, 44. Then first of all, for calculating median we have to arrange the scores in ascending or descending order like 15, 17, 25, 39, 44, 47. Here N (= 7) is odd and therefore the score of the (N + 1)/2th or 4th student, i.e. 35 is the median of given scores.

(*ii*) *Where N (the number of items in a series) is even*–In the case where N is even (divisible by 2), then the median is determined by this following formula–

$$M_d = \frac{\text{Total value of } (N/2)\text{th and } (N/2+1)\text{th item}}{2}$$

Example–Let there be a group of 8 students, whose scores are 17, 47, 15, 35, 39, 50, 44.

For calculating the median of these scores we will proceed as under:

Arrangement of scores in proper order 15, 17, 25, 35, 39, 44, 47, 50.

The score of the (N/2)th =35 i.e. 4th students

The score of the (N/2 + 1)th = 39 i.e. 5th student

Then Median = $\frac{35+39}{2} = 37$

Computation of the median for grouped data (data in the form of a frequency distribution)

If the data is available in the form of a frequency distribution like the following:

Scores	*f*
65–69	1
60–64	3
55–59	4
50–54	7
45–49	9
40–44	11
35–39	8
30–34	4
25–29	2
20–24	1
	N = 50

Then calculating of median first requires the location of median class. Actually as defined earlier, median is the measure or score of the central.

Therefore, it is needed which is the central item whose measure we aim to determine. It is done through the formula given above in the case of ungrouped data depending upon the odd and even. nature of total frequencies (N). Here in the present distribution N (= 50) is even, therefore, median will fall somewhere between the scores of 25th and 26th items in the given distribution. In the present example if we add frequencies from the above or below we can know that the class interval designated as 40–44 can be labelled as the class where the score representing median lies.

After estimating the median class the median of the distribution can be interpolated from the following formula.

$$M_d = L + \frac{N/2 - F}{f} \times i$$

Where L = Exact lower limit of the median class.

F = Total of all the frequencies before the median class.

f = Frequency of the median class.

i = Class interval.

N = Total of all the frequencies.

By applying the above formula we can compute the median of the given distribution in the following way:

$$M_d = 39.5 + \left(\frac{50/2}{11}\right) \times 5 = 39.5 + \frac{10}{11} \times 5$$

$$= 39.5 + \frac{50}{11} = 39.5 + 4.55 = 44.05$$

Some Special situations in the computation of Median

Scores (*a*)	*f*	*Scores* (*b*)	*f*	*Scores* (*c*)	*f*
55–59	5	45–49	2	20–21	2
50–54	3	40–44	5	18–19	1
45–49	8	35–39	6	16–17	0
40–44	18	30–34	0	14–15	0
35–39	15	25–29	8	12–13	2
30–34	10	20–24	3	10–11	0
25–29	7	15–19	2	8–9	0
20–24	2			6–7	2
				4–5	1
				2–3	1
				0–1	1
	$N = 68$		$N = 26$		$N = 10$

Let us think about the medians of the above distribution.

(*a*) We know by definition that median is the point on the score scale below and above which 50% cases lie. Observing through this definition the score representing median should be a common score falling between the class 35–39 and 40-44. This score is nothing but the upper limit of the class 35–39 which is also the lower limit of the class 40–44. Therefore, in this case median is 39–5.

(*b*) In the 2nd distribution, if we try to add the frequencies from below we see that up to class interval 25–29, 13 cases lie and by adding frequencies from above we also find that up to the class interval 35–39, 13 cases lie. In this way, the class interval 30–34 divides the distribution into two equal parts below and above which 50% cases lie. It leads us to conclude that median should be the mid-point of the class interval 30–34 and therefore 32 is the median of this distribution.

(*c*) In the 3rd case if we add the frequencies from below we find that upto the class interval 6–7, 5 cases lie and by adding the frequencies from above.

We also find that upto the class 12–13, 5 cases lie. The median should fall in the mid-way between the two classes 8–9, and 10–11. It should be the common score represented by both these classes. This score is noting but the upper limit of the class 8–9 and lower limit of the class 10–11 and therefore, it should be 9.5.

MODE (M_O)

Mode is defined to be the size of the variable (say a score) which occurs most frequently. It is the point on the score scale that corresponds to the maximum frequency of the distribution. In any series it is the value of the item, which is most characteristic or common and is usually repeated maximum number of items.

Computation of Mode

(a) In case of ungrouped data

In the case of ungrouped data mode can be easily computed merely by looking at it. All that one has to do is to find out the score which is repeated maximum number of times.

Example– Suppose we have to find out the value of the mode from the following scores of the students:

25, 29, 24, 27, 28, 25, 29

Here the score 2.5 is repeated maximum number of times and thus value of the mode in this case is 25.

(b) In Case of grouped data

In the case where data, is available in the form of a frequency distribution, the mode (M_o) = $3M_d - 2M$ where M_d is the median and M, the mean of the given distribution of all mean as well as median of the distribution are computed and then with the help of the above formula Mode is calculated. For illustration we can take the distribution previously given in the Table 16.2. We-know the mean and median of this distribution. Now we can use these results for the computation of the mode.

$M_d = 44.05$, $M = 44.6$

Therefore, $M_o = 3 \times 44.05 - 2 \times 44.6$

$= 132.15 - 89.2$

$= 42.95$

When to use the Mean, Median and Mode

Computation of any of the three-mean, median and mode-provides a measure of central tendency. Now which of them should be computed for a particular distribution is a question that can be raised quite

often. Below we pay attention over this aspect in light of the characteristics and nature of all these measures.

When to Use the Mean

(*i*) Mean is the most reliable accurate measure of the central tendency of a distribution in comparison to median and mode. It has the greatest stability as there are less fluctuations in the means of the samples drawn from the same population. Therefore, in the case where a reliable and accurate measure of central tendency is needed, we compute mean for the given data.

(*ii*) Mean can be given an algebraic treatment and is better suited to further arithmetical computation. Therefore, it can be easily employed for the computation of various statistics like Standard Deviation, Coefficient of correlation etc. Hence, when we need to know such statistics, mean is computed for the given data.

(*iii*) In computation of the mean we give equal weightage to every item in the series. Therefore, it is affected by the value of each item in that series. Sometimes, there are extreme items which seriously affect the position of the mean. Therefore, it is not proper to compute mean for the series that have extreme items. It should be calculated only when the series has no extreme items and each score carries equal weight in determining the central tendency.

When to Use the Median

(*i*) Median is the exact mid-point of a series as 50% cases lie below and above it. Therefore, when the exact mid-point of the distribution is desired, median is to be computed.

(*ii*) Median is not affected by the extreme scores in the series. Therefore, when a series contains extreme scores, the median is perhaps the most representative central measure.

(*iii*) In case of an open end distribution (incomplete distribution “80 and above” or “20 and below” etc.) mean is impossible to be calculated.

(*iv*) Mean cannot be calculated graphically. But in case of median we can compute it graphically. Therefore, when we have suitable graphs like Frequency curve, Polygon etc. we should try to compute median.

(*v*) The median is specifically useful for the data the items of which cannot precisely be measured quantitatively e.g. qualities like health, culture, honesty, intelligence etc.

When to Use the Mode

(*i*) In many crude mode can be computed by just having a look at the date. It gives the quickest, although approximate, measure of central tendency. Therefore, in cases where a quick and approximate measure of central tendency is all that is desired, we compute mode.

(*ii*) Mode is that value’ of the item which occurs most frequently or is repeated maximum number of times in a given series. Therefore, when we need to know; the most often recurring score or value of the items in a series, we compute mode. On account of the characteristic mode has unique importance in the large scale manufacturing of consumption goods. In finding the sizes of the shoes and ready-made clothes which will fit most men, the manufacturer makes use of the average indicated by mode.

(*iii*) Mode can be computed from the histogram and other frequency curves. Therefore, when we already have a graphically representation of the distribution in the form of such figures, it is appropriate to compute mode instead of mean.

EXERCISES

Essay Type Questions

1. Compute Median for the following Ungrouped data:
   (*i*) 16, 2, 10, 9, 4, 7, 12, 4, 150.
   (*ii*) 8, 3, 10, 5, 2, 11, 14, 12.
   Ans. (*i*) 10 (*ii*) 9
2. Find the crude Mode for the following data:
   15, 14, 8, 14, 14, 11, 9, 9, 11.
   Ans. 14
3. Compute the Mean, Median and Mode for the following distribution:

Scores	*f*	*Scores*	*f*	*Scores*	*f*	*Scores*	*f*
(a)		*(b)*		*(c)*		*(d)*	
70–71	2	120–122	2	45–49	2	135–144	1
68–69	2	117–119	2	40–44	3	125–134	2
66–67	3	114–116	2	35–39	2	115–124	8
64–65	4	111–113	4	30–34	17	105–114	22
62–63	6	108–11 0	5	25–29	30	95–104	33
60–61	7	105–107	9	20–24	25	85–94	22
58–59	5	102–104	6	15–19	15	75–84	9
56–57	1	99–101	3	10–14	3	65–74	2
54–55	2	96–98	4	5–9	2	55–64	1
52–53	3	93–95	2	0–4	1		
50–51	1	90–92	1				
	N–36		*N* = 40		*N* = 100		*N* = 100

Ans.

(*a*)	(*b*)	(*c*)	(*d*)
$M = 6111$	$M = 106.00$	$M = 25.05$	$M = 993$
$M_d = 6121$	$M = 105.83$	$M_d = 25.17$	$M_d = 993$
$M_o = 6141$	$M_o = 105.49$	$M_o = 25.41$	$M_o = 993$

4. What do you understand by mean and median? Explain by computing these for the scores in a test given below. (Taking 2 as class interval)

72	75	77	67	72
91	78	65	86	83
67	82	76	76	70
83	71	63	72	72
61	67	84	69	64

5. What do you mean by measures of central tendency? Name different measures of central tendency and discuss them in brief.
6. What is Arithmetic Mean (M)? How is it computed in the cases of ungrouped and grouped data? Discuss with hypothetical examples.
7. What is median (M_d)? How is it computed in the cases of ungrouped and grouped data? Discuss with. the help of a hypothetical example.
8. What is mode (M_o)? How is it computed 'in the cases of ungrouped and grouped data? Discuss with the help of a hypothetical example.
9. Explain which of the three mean, median and mode should be computed for a particular distribution in a specified situation.
10. Calculate the Mean, Median and Mode of the following frequency distribution.

Class Interval	*Frequency*
195–199	1
190–194	2
185–189	4
180–184	5
175–179	8
170–174	10
65–169	6
160–164	4
155–159	4
150–154	2
145–149	3
140–144	1

Ans. $M = 170.8$, $M_d = 172$, $M_o = 174.4$

5. Calculate the mean, Median and Mode of the following distribution.

Class Interval	35–39	30–34	25–29	20–24	15–19	10–14
Frequency	4	8	15	10	8	5

Ans. $M = 24.5$, $M_d = 28.83$, $M_o = 37.49$

Short Answer Type Questions (Answer in 100-120 words)

1. What are the measures of central tendency? Name their various types.
2. What is mean? How is it computed?
3. What is median? How is it computed?
4. What is mode? How is it computed?
5. When and where is the need of the computation of mean for a given data?
6. When and where is the need of the computation of median for a given data?
7. When and where is it useful to compute mode in the case of a given data?

Chapter 20

Measures of Variability

Measure of central tendency-mean, median and mode-provide central value or typical representative of a set of scores as a whole. Through these measures we can represent a characteristic or quality of the whole group by a single number. By comparing such typical representative of the different sets of scores we can compare the achievement of the two groups. But these representative numbers give us merely an idea of the general achievement of the group as a whole, and does not show how the individual scores are spread out. Therefore, through measures of central tendency we are unable to know much about the distribution of scores in a series or characteristics on items in a group. Hence, measures of central tendency provide insufficient base for the comparison of two or more frequency distribution or sets of scores. It can be made more clear from the following example.

Let there be two small groups of boys and girls whose scores in an achievement test are such as the following:

Test Scores of Group A (boys) – 40, 38, 36, 17, 20, 19, 18, 3, 5, 4

Test Scores of Group B (girls) – 19, 20, 22, 18, 21, 23, 17, 20, 22, 18.

Now the value of the Mean in both the cases is 20 and thus, so far as the mean goes, there is no difference in the performance of the two groups. Now the question arises, can we take both sets of scores as identical? Definitely there is a lot of difference between the performance of two groups. Whereas the test scores of group A are found to range from 30 to 40, the scores in group B range from 18 to 23. First group in composed of individuals who have wide individual difference. It contains either very capable or very individuals. The second group, on the other hand is composed of average individuals. Individuals in this latter group are less variable than those of the former. Looking in this way, there is a great need of paying consideration to the variability or dispersion of the scores in the sets of scores or series if we want to describe and compare them.

DIFFERENT MEASURES OF VARIABILITY OR DISPERSION

These are chiefly, four measures of indicating variability or dispersion within the set of scores. They are:

(*a*) The Range (R)

(*b*) The Quartile Deviation (Q)

(*c*) The Average Deviation (AD)

(*d*) The Standard Deviation (SD)

Each of the above measures of variability gives us the degree of variability or dispersion by the use of a single number and tells us how the individual scores are scattered or spread over throughout the distribution or gives data.

In the following pages we will discuss these measures in brief.

Range (R)

Range is the simplest measure of variability or dispersion. It is calculated by subtracting the lowest scores in the series from the highest. But it is very rough measure of the variability of a series. It takes only extreme scares into consideration and tells nothing about the variation of the individual items.

Quartile Deviation (Q)

It is computed by the formula $Q = (Q_3 - Q_1) / 2$, where Q_1 and Q_3 represent the 1st and 3rd quartiles of the distribution under consideration. The amount Q_3 and Q_1 is nothing but the difference of range between 3rd and 1st quartile. It is designated as the inter quartile range. For computing Quartile Deviation, this interquartile range is divided by 2 and therefore, *Q*uartile Deviation is also named as semi-interquartile range. In this way, for computing *Q*, the values of Q_1 and Q_3 are first determined and then by applying the above formula we try to get the value of Quartile Deviation.

Average Deviation (AD)

"Average Deviation or AD" as Garrett defines it, "is the mean of the deviation of all the separate scores in the series taken from their mean (occasionally from the median or mode)." (1971, p. 481)

It is the simplest measure of variability that takes into account the fluctuation or variation of all the items in a series.

(*i*) Computation of Average Deviation (*AD*) from ungrouped data.

In the case of ungrouped data *AD* is calculated by the formula–

$$AD = \frac{\Sigma | x |}{N}$$

Where $x = X - M$ = Deviation of the score from the mean of the series and x signifies that in the deviation values we ignore the algebraic signs +ve and –ve.

The use of this formula can be explained through the following example.

Example–Find out the Average Deviation of the scores 15, 10, 6, 8, 11 of a series.

Solution–The mean of given series =15 + 10 + 6 + 8 + 11 = 10

Scores	*Deviation from the mean* $(X - M) = x$	$\|x\|$
15	5	5
10	0	0
6	– 4	4
8	– 2	2
11	1	1
$N = 5$		$\|x\| = 12$

By applying the formula– $AD = \frac{\Sigma | x |}{N} = 12 - 2.4$

(*ii*) Computation of Average Deviation from grouped data

From grouped data AD can be computed by formula– $AD = \frac{\Sigma | x |}{N}$

Use of this formula can be understood through the following Illustration.

Score	*f*	*Mid-point X*	*fx*	*x = (X –100.06)*	*fx*	*| fx |*
110-114	4	112	448	11.94	44.76	47.76
105-109	4	107	428	6.94	27.76	27.76
100-104	3	102	306	1.94	5.82	5.82
95-99	0	97	0	– 3.06	0	0
90-94	3	92	276	– 8.08	–24.18	24.18
85-89	3.87	261	–13.36	– 39.18	39.18	
80-84	1	82	82	–18.06	–18.06	18.06
	N = 18		1801			162.67

First of all Mean is computed

$$\text{Here Mean} = \frac{\Sigma fx}{N} = \frac{1801}{18} = 100.06$$

Then we calculate the values of x by subtracting. Mean from the respective values of x and enter them into V column. By multiplying these values by the respective class frequencies and ignoring the algebraic sign we get the values of Σ |*x*| Afterward we apply the formula below

$$AD = \frac{\Sigma | fx |}{N} = \frac{162.76}{18} = 9.04$$

STANDARD DEVIATION (SD)

Standard Deviation of a set of a scores is defined as the square root of the average of the squares of the deviation of each from the mean.

Symbolically we can say that $SD = \sqrt{\frac{\Sigma (X - M)^2 N}{}} = \sqrt{\frac{\Sigma x^2}{N}}$, where *X* stands for individual score, M for mean of the given set of scores. *N* for total number of the scores and x for the deviation of each score from the mean.

Standard Deviation is regarded as a most stable and reliable measure of variability as it employs mean for its computation. It is often called as root-mean square deviation and is denoted by the Greek letter sigma.

(*a*) Computation of Standard Deviation (SD) from Ungrouped Data

SD can be, computed from the ungrouped scores by the following formula $\sigma = \sqrt{\frac{\Sigma x^2}{N}}$.

Below we illustrate the use of this formula by taking a particular example.

Example–Calculate SD for the following set of test scores:
52, 50, 56, 68, 65, 57, 70

Solution–Mean of the given scores = 480/8 = 60

Scores X	*Deviation from the mean (X – M) or x*	*Squares of Deviations*
52	– 8	64
50	– 10	100
56	– 4	16
68	8	64
65	5	25
62	2	4
57	– 3	9
70	10	100
		$Sx^2 = 382$

Now $\sigma = \sqrt{\frac{\Sigma x^2}{N}} = \sqrt{\frac{382}{8}} = \sqrt{47.75} = 6.91$

(b) Computation of SO from the Grouped Data"

SD in case of grouped data can be computed by formula $\sigma = \sqrt{\frac{\Sigma x^2}{N}}$.

The use of the formula can be understood through the solution of the following example.

Problem – Compute SD for the frequency distribution given below on the extreme left. The mean of this distribution is 115.

I.Q. Scores	*f*	*X*	*M*	*X*	x^2	fx^2
127–129	1	128	115	13	169	169
124–128	2	125	115	10	100	200
121–123	3	122	115	7	49	147
118–120	1	119	115	4	16	16
115–117	6	116	115	1	1	6
112–114	4	113	115	– 2	4	16
109–111	3	110	115	– 5	25	75
106–108	2	107	115	– 8	64	128
103–105	1	114	115	– 11	121	121
100–102	J	101	115	– 14	196	196
$N = 24$						$Sfx^2 = 1074$

Now $\sigma = \sqrt{\frac{\Sigma x^2}{N}} = \sqrt{\frac{1074}{24}} = \sqrt{44.75} = 6.69$

In the above computation work we have made use of M, the mean of the distribution. If not given in the example, it can be computed in the following way:

Calculation of Mean–Let Assumed Mean be 116.

Scores	*f*	*x (Mid-value)*	$x' = \frac{X - A}{i}$	*fx′*
127–129	1	128	4	4
124–126	2	125	3	6
121–123	3	122	2	6
118–120	1	119	1	1
115–117	6	116	0	0
112–114	4	113	– 1	– 4
109–111	3	110	– 2	– 6
106–108	2	107	– 3	– 6
103–105	1	104	– 4	– 4
100–102	1	101	– 5	– 5
	N = 24			*fx′* = – 8

Formula: $$M = A + \frac{\Sigma x'}{N} \times i = 116 - \frac{8}{24} \times 3 = 116 - 1 = 115$$

Mean = 115

(c) Computation of SD from Grouped Data by Short-cut Method

SD from grouped data can also be computed by the following formula:

$$\sigma = \sqrt{\frac{\Sigma f x'^2}{N} - \left(\frac{\Sigma f x'^2}{N}\right)}$$

Where the notation have the same meaning as desired earlier. The use of this formula can be explained by solving the example given under the case (b).

I.Q. Scores	*f*	*X*	$x' = \frac{X - A}{i}$	*fx′*	fx'^2
127–129	1	128	4	4	16
124–126	2	125	3	6	18
121–123	3′	122	2	6	12
11–120	1	119	1	1	1
115–117	6	116	0	0	0
112–114	4	113	– 1	– 4	4
109–111	3	110	– 2	– 6	12
106–108	2	107	– 3	– 6	18
103–105	1	104	– 4	– 4	16
100–102	1	101	–5	– 5	25
	N = 24			*Sfx′*1 = –8	Sfx'^2 = 122

Formula– $\sigma = i\sqrt{\frac{\Sigma fx'^2}{N} - \left(\frac{\Sigma fx'}{N}\right)^2} = 3\sqrt{\frac{122}{4} - \left(\frac{-8}{24}\right)^2}$

$$= 3\sqrt{\frac{122}{4} - \frac{64}{24\times 24}} = \frac{3}{24}\sqrt{122\times 24 - 34} = \frac{1}{8}\sqrt{2864} = \frac{53.51}{8}$$

Standard Deviation = 6.69

EXERCISE

Essay Type Questions

1. What do you understand by dispersion or variability of the scores in a given series? Discuss in brief the different measures of variability.
2. Calculate average Deviation from the following Data:

   (*a*) Scores 30, 35, 36, 42, 46, 38, 34, 35

   (*b*)

Scores	80–84	85–89	90–94	95–991	00–104	105–109	110–114
f	4	4	3	0	3	3	1

   N = 18

   Ans. (*a*) 3.9, (*b*) 2.04
3. Compute Standard Deviation for each of the four frequency distributions a, b, c, d, given in problem 3 of the chapter 18.

   Ans. (*a*) 4.99, (*b*) 7.73, (*c*) 7.7, (*d*) 13.4
4. What are the measures of variability or dispersion? Discuss the need of their computation.
5. What is average deviation? Discuss the procedure of its computing from the ungrouped as well as the grouped data with the help of an hypothetical examples.
6. What is Standard Deviation? Discuss the procedure of its computation from the ungrouped as well as grouped data with the help of some hypothetical data. Calculate Mean and Standard Deviation for the following data.
7. Calculate mean and standard deviation for the following data:

(a) Scores	*f*	*(b) Score*	*f*
60–69	4	40–44	1
50–59	4	35–39	2
40–49	4	30–34	3
30–39	10	25–29	4
20–29	8	15–19	15
10–19	5	10–14	5
0–9	5	5–9	8

   Ans. (*a*) *M* =36.75, *SD* =17.815, (*b*) *M* = 18.98, *SD* = 8.52

8. Calculate Mean and Standard Deviation for the following data:

(a) Scores	*f*	*(b) Scores*	*f*
45–49	2	55–59	1
40–44	3	50–54	1
35–39	5	45–49	3
30–34	9	40–4	4
25–29	6	35–39	6
20–24	4	30–34	7
15–19	1	25–29	12
		20–24	6
		15–19	8
		10–14	2

Ans. (*a*) $M = 32$, (*b*) $M = 29.6$

$SD = 7.415$, $SD = 10.45$

9. Compute Mean and Standard Deviation for the following data:

(a) Scores	*f*	*(b) Scores*	*f*	*(c) Scores*	*f*
45–49	2	90–93	1	85–87	1
40–44	3	86–89	3.	82–84	3
35–39	2	82–85	8	79–81	2
30–34	6	78–81	5	76–78	. 3
25–29	8	74–77	7	7–75	3
20–24	8	70–73	6	70–72	2
15–19	7	66–69	4	67–69	2
10–14	5	62–65	2	64–66	3
5–9	9			61–63	1

Ans. (*a*) $M = 22.4$, (*b*) $M = 77.06$, (*c*) $M = 14.15$

$SD = 113$, $SD = 7.13$, $SD = 6.936$

10. Compute Quartile Deviation from the following data:

(a) Scores	*f*	*(b) Scores*	*f*
45–49	2	135–144	1
40–44	3	125–134	2
35–39	2	115–124	8
30–34	17	105–114	22
25–29	30	95–104	33
20–24	25	85–94	22
15–19	15	75–84	9
10–14	3	65–74	2
5–9	2	55–64	1
0–4	1		

Ans. (*a*) 4.5 (*b*) 8.85

11. Compute Standard Deviation for the data presented in the problems 10 and 11 of the chapter 18.
Ans. Problem 10, *SD* = 12.62, Problem 11, *SD* =7.017

Short Answer Type Questions (Answer in 100-120 words)

1. What is a range as a measure of variability? Illustrate its computation through an example.
2. What are the measures of variability or dispersion? Name the various measures of variability.
3. What is quartile deviation? How is it computed? Explain with the help of an example.
4. Tell about the average deviation as a measure of variability.
5. Tell about the standard deviation as a measure of variability.
6. Write short note on the need of computing measure of variability or dispersion.

Chapter 21

Correlation

In Social Study as well as Psychology there are times where it is needed to know whether there exists any relationship between the different abilities of the individual or they are independent of each other. Consequently, there are numerous questions like the following which, have to be answered.

(*i*) Does scholastic achievement depend upon the general intelligence of a child?

(*ii*) Is it true that the height of the children increases with the increase in their age?

(*iii*) Is there are relationship between the size of the skull and general intelligence of the individuals?

(*iv*) Is it true that Dull children tend to be more neurotic than the bright children?

The questions and problems like the above in which there is a need of finding out the relationship between two variables (Age and Height Intelligence and Achievement etc.) can be tackled properly by the method of correlation.

There are many types of correlation like Linear, Curvilinear, Biserial, Partial or Multiple correlation that are computed in Statistics. As we, in this text, aim to have an elementary knowledge of the statistical methods we will take only the Linear correlation in the following pages.

LINEAR CORRELATION

This the simplest kind of correlation to be found between the two sets of scores or variables. Actually when the relationship between two sets of scores or variables can be represented graphically by a straight line, it is known as Linear Correlation. Such type of correlation clearly reveals how the change in one variable is accompanied by a change or to what extent increase or decrease in one is accompanied by the increase or decrease in order.

The correlation between two sets of measures of variables can be positive or negative. It is said to be positive when an increase (or decrease) in the corresponds to an increase (or decrease) in the other. It is negative when increase corresponds to decrease and decrease corresponds with increase. There is also possibility of third type of correlation i.e. zero correlation between the two sets of measures of variables if there exists no relationship between them.

COEFFICIENT OF CORRELATION

For expressing the degree of relationship quantitatively between two sets of measures of variables we usually take the help of an index that is known as coefficient of correlation. It is a kind of ratio which expresses the extent to which changes in one variable are accompanied with changes in the other variable. It involves no units and varies from -1 (indicating perfect negative correlation) to + 1 (indicating perfect positive correlation). In case the coefficient of correlation is zero it indicates zero correlation between two sets of measures.

COMPUTATION OF COEFFICIENT OF CORRELATION

There are two different methods of computing coefficient of correlation (linear).

There are–

(*a*) Rank Difference Method

(*b*) Product Moment Method

(*a*) Rank Difference Method of Computing Coefficient of Correlation

In computing coefficient of correlation between two sets of scores achieved by the individuals, with the help of this method we require ranks i.e. positions of merits of these individuals in the possession of certain characteristics. The coefficient of correlation computed by this method as it considers only the ranks of the individuals in the characteristics A and B is known as Rank correlation coefficient and is designated by Greek letter (Rho). Some times it is also known as Spearman's coefficient of correlation after the name of its inventor.

In case where we do not have scores and have to work with data in which differences between the individuals in the possession of certain characteristics can be expressed only by ranks. Rank correlation coefficient is the only correlation coefficient that can be computed. But this does not mean that it cannot be computed from the usual data given in scores. In case the data contain scores of individuals, we can compute by converting them into ranks. For example, if the marks of a group of 5 students are given as 17, 25, 9, 35,18, we will rank them as 4, 2, 5, 1 and 3. We determine the rank of position of the individuals in both the given sets of scores. These ranks are then subjected to further calculation for the determination of the coefficient of correlation.

How it is done can be understood properly through the following illustration-

Example 22.1

Individual	*Marks in the subject of History*	*Marks in the subject of Civics y signs +ve or –ve* $d = R_1 - R_2$	*Rank in History* R_1	*Rank in Civics* R_2	*Difference in Rank irrespective of*	*Difference squared* D^2
A	80	82	2	3	1	1
B	45	86	11	2	9	81
C	55	50	10	10	0	0
0	56	48	9	191	2	4
E	58	60	8	9	1	12
F	60	62	7	8	1	1
G	65	64	6	7	1	1
H	68	65	5	6	1	1
I	20	70	4	5	1	1
J	75	74	3	4	1	1
K	85	90	1	1	0	1

$N = 11, \Sigma d^2 = 92$

Formula $$p = 1 - \frac{6\Sigma d^2}{N(N^2 - 1)}$$

$$= 1 - \frac{6 \times 92}{11(11^2 - 1)} = 1 - \frac{6 \times 92}{11 \times 120}$$

$$= 1 - \frac{33}{55} = 1 - 42 = 0.58$$

Example 22.2

Individuals	*Scores in Test X*	*Scores in Test Y*	*Rank in* X_1R_1	*Rank in* X_2R_2	$R_1 - R_2 = d$	D^2
A	12	21	8	6	2	4
B	15	25	6.5	3.5	3	9
C	24	35	2	2	0	0
D	20	24	4	5	1	1
E	8	16	10	9	1	1
F	15	18	6.5	7	0.5	0.25
G	20	25	4	3.5	0.5	0.25
H	20	16	4	9	5	25
I	11	16	9	9	0	0
J	26	38	1	1	0	0
$N = 10$						$\Sigma d^2 = 40.5$

Formula $$p = 1 - \frac{6\Sigma d^2}{N(N^2 - 1)}$$

$$= 1 - \frac{6 \times 40.5}{10(10^2 - 1)} = 1 - \frac{6 \times 40.5}{10 \times 99}$$

$$= 1 - \frac{8.1}{33} = 1 - 0.245 = 0.755$$

Steps for Calculation of *p*

1. First of all it is required to assign position of merit or rank to each individual join either test. These ranks are put under column 3. (designated as R_1) and 4 (designated as R_2) respectively. The task of assigning ranks in the cases like example 1st is not difficult. But in the cases, like

example 2nd, where two or more individuals are found to achieve same score, some difficulty arises. In the above example, in the first test *X*, *B* and *F* are two individuals who have the same score i.e. 15. Therefore, score 15 occupies 6th position in order of merit. But now the question arises which one of the two individuals *B* and *F* should be ranked as 6th or 7th. In order to overcome this difficulty we equally share the rank 5th and 7th between them and thus rank each one of them as 6.5.

Similarly, if there are three persons who have the same score and share the same ranks, we take the average of the ranks claimed by these persons. For example, we can take the score 20 in the 2nd example which is shared by three individuals *D*, *G* and *H*. It is ranked third in the whole series and therefore the ranks 3, 4 and 5 are shared equally by *D*, *G* and *H* and hence we attribute rank to each of them.

2. After writing down the allotted rank to all the individuals 0 either of the two tests, the differences in these ranks are calculated. In doing so we do not 'consider the algebraic signs +ve or –ve of the difference. This difference is written under column 5th (designated as $|d|$.
3. In the next column (designated as d^2) we square up the Rank difference or the values of d written in the column 5th.
4. Now we calculate the total of all the values of d^2 and this sum is designated as Σd^2 .
5. Now the value of p is calculated by the formula $\rho = 1 - \frac{6\Sigma d^2}{N(N^2-1)}$, where d^2 stands for the sum of the squares of differences between the ranks of the scores on two different tests and N for the number of individuals whose scores are under consideration for computing.

(*b*) Product Moment Method of Computing Coefficient of Correlation

This method is also known as Pearson Moment method in the honour of the English statesman Karl Pearson who is said to be the inventor of this method. The coefficient of correlation computed by this method is known as Product Moment coefficient of correlation symbolically represented by '*r*'.

(*a*) The calculation of '*r*' from ungrouped data

The basic formula for the computation of '*r*' for the ungrouped data by this method is $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

Where x and y represent the deviation of scores in the tests *X* and *Y* from the means of each distribution.

The procedure of calculation *r* by this formula can be understood by the following illustration-

Individuals	*Scores in*	*Scores in*	*X*	*Y*	*Xy*	X^2	Y^2
A	15	60	–10	10	–100	100	100
B	25	70	0	20	0	0	400
C	20	40	–5	–10	50	25	190
D	30	50	5	0	0	25	0
E	35	30	–10	–20	–200	100	400
					$\Sigma xy = -250$	$\Sigma x^2 = 250$	$\Sigma y^2 = 1000$

Mean of series X, $(M)_x$ =25
Mean of series Y $(M)_y$ = 50

Formula $r = 1 - \dfrac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$

$$= \frac{-250}{\sqrt{250 \times 1000}} = \frac{-250}{\sqrt{250000}}$$

$$= \frac{-250}{500} = \frac{1}{2} = -0.5$$

(*b*) Computation of *r* directly from raw scores when deviations are taken from zero (without calculating deviations from the means. Here we apply the formula.

Subject	*Scores in 1st Test (X)*	*Scores in 2nd Test (Y)*		X^2	Y^2
A	5	12	60	25	144
B	3	15	45	2	225
C	2	11	22	4	121
D	8	10	80	64	100
E	6	18	108	36	324

$$r = \frac{5 \times 15 - 24 - 66}{\sqrt{(5 \times 138 - 576)} \times \sqrt{(5 + 914 - 66 \times 66)}}$$

$$= \frac{1575 - 1650}{\sqrt{(690 - 576)} \times \sqrt{(1470 - 4356)}}$$

$$= \frac{-75}{\sqrt{24396}} = \frac{-75}{1562} = -0.48$$

Ans. R = – 0.48

EXERCISES

Essay Type Questions

1. What is correlation in Statistics? Discuss its types. How is it useful in the field of education?
2. Find the correlation between the following two sets of scores using product moment method.

Subiect	A	B	C	D	E	F	G	H
Test X	15	18	22	17	19	20	16	21
Test Y	40	42	50	45	43	46	41	41

Ans. $r = 0.65$

3. Find the correlation between the following two set of raw scores without computing deviation from the mean.

4.

Subiect	A	B	C	0	E	F	G	H	I	T
Test X	13	12	10	8	7	6	6	4	3	1
Test Y	7	11	3	7	2	12	6	2	9	6

Ans. $r = 0.14$

4. Compute the coefficient of correlation between the following two series of test scores by Rank difference method.

(a) Pupils	*Test X*	*Test Y*	*(b) Pupils*	*Test X*	*Test Y*
	40	42		12	16
B	36	35	B	26	25
C	27	28	C	21	15
D	18	27	D	23	21
E	13	15	E	25	22
F	48	48	F	15	21
G	43	50	G	18	27
H	25	27	H	22	30
I	29	32	I	18	28
T	17	21	J	19	23

Ans. (*a*) 0.985, (*b*) 0.188

5. Find the correlation coefficient between the following set of scores using product moment method.

Subject	A	B	C	D	E	F	G	H	I	J
Test X	13	12	10	10	8	6	6	5	3	2
Test Y	11	14	11	7	9	11	3	7	6	1

Ans. 0.76

6. Find the Rank correlation coefficient from the following data.

Subject	A	B	C	D	E	F	G	H
Test *X*	30	40	50'	20	10	45	22	18
I Test *Y*	55	75	60	12	11	38	25	15

Ans. 0.86

7. What is coefficient of correlation? Calculate the coefficient of correlation by Rank order Method in the following groups.

Group (X)	50	62	68	69	73	73	78	81
Group (Y)	24	20	22	18	18	18	19	10

Ans. – 0.756

8. Calculate the coefficient of correlation by Rank difference method from the following data.

Students	A	B	C	0	E	F	G
Test X	32	28	35	26	22	20	30
Test Y	27	25	26	22	15	18	24

Subject	A	B	C	D	E	F	G	H
Test X	20	22	24	18	27	30	28	23
Test Y	35	40	32	30	38	39	34	33

Ans. 0.357

10. What is coefficient of correlation? Discuss in brief about the Rank difference and product moment methods of computing coefficient of correlation.
11. What is Rank difference method of computing coefficient of correlation? Discuss its procedure with the help of hypothetical example.
12. What is product moment method of computing coefficient of correlation? Discuss its procedure with the help of hypothetical example.

Short Answer Type Question (Answer in 100-120 words)

1. What is correlation? Explain the need of finding correlation between two variables in the field of education.
2. What is linear correlation? Mention its various types.
3. What is coefficient of correlation? Name the different methods of computing coefficient of correlation.
4. What is the Rank difference method of computing coefficient of correlation?
5. What is the product moment method of computing coefficient of correlation?
6. Mention and explain the formula for computing Rank correlation coefficient.
7. Mention and explain the formula for computing correlation coefficient by Product Moment method.

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