



**M.A. EDUCATION
SEMESTER - II (CBCS)**

**CORE COURSE- VI
RESEARCH METHODOLOGY
IN EDUCATION**

SUBJECT CODE - CCMAED06

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**MA EDUCATION
SEMESTER II
CORE COURSE VI**

RESEARCH METHODOLOGY IN EDUCATION

Theory: 60 Internals: 40

Total Marks 100

Total Credits= 6

Course Objectives

- a. To explain the conceptual framework of educational research
- b. To explain the conceptual framework of research design
- c. To explain the types of variables and hypotheses in research.
- d. To explain the types of research
- e. To understand the various tool and techniques in research.
- f. To explain how to write a research report.

Module I: Educational Research and Research Design Credits: 2

Unit 1: Educational Research

- a) Educational Research: Meaning, Scope of Educational Research, Types of Research: Fundamental, Applied and Action Research
- b) Ethical considerations in Educational Research: Sources Acquiring Knowledge, Scientific Method, Difference between Research Method and Research Methodology
- c) Research proposal: Meaning and Components of Research Proposal

Unit 2: Research Design

- a) Research Design: Meaning, Definition, Purpose and Components of Research Design
- b) Population and Sample: Concept, Sampling: Techniques of sampling, Types Probability and Non-Probability Sampling
- c) Review of Related Literature – Purpose, Need and Organization

Unit 3: Variables and Hypotheses

- a) Variables: Meaning, Types of variables (Independent, Dependent, Extraneous, Intervening and Moderator), Controlling Extraneous and Intervening Variables

- b) Hypothesis: Concept, Sources of hypothesis and Types of hypotheses (Research, Directional, Non-Directional, Null, Statistical and Question form)
- c) Formulating Hypothesis: Characteristics of a good Hypothesis, Testing of Hypothesis, Significance of Test, Errors in Testing of Hypothesis

Module II: Paradigm, Tools and Data Analysis in Research Credits: 2

Unit 4: Quantitative and Qualitative Research

- a) **Quantitative Research:** Concept, Types: Descriptive Research, Co-relational Research, Causal-Comparative Research, Experimental Research, Survey Research
- b) **Qualitative Research:** Concept, Types: Ethnography, Case Study and Historical research
- c) **Experimental Designs:**
 - i. Types: Pre-experimental design, Quasi-experimental design and True experimental design
 - ii. Internal and External Experimental Validity, Factorial Design, Nested Design, Single Subject Design

Unit 5: Tools and Techniques of Research

- a) Types of Measurement Scale and Research Tools
- b) Types of Tools - Rating scale, Attitude scale, Opinionnaire, Questionnaire, Checklist, Semantic Differentiate scale, Psychological Test, Inventory and Observation
- c) Steps of Preparing a Research Tool – Validity and Reliability: Concepts and Types method of estimating reliability, Item Analysis: Steps involved in Item – Analysis

Unit 6: Data Analysis and Report Writing

- a) Quantitative Data Analysis -
 - i. Parametric Techniques, Non- Parametric Techniques, Conditions for using parametric and non-parametric techniques
 - ii. Data Analysis: Descriptive data analysis: Measures of central tendency, variability, fiduciary limits and graphical presentation of data), Inferential data analysis: Correlation, t-test, z-test, ANOVA, Critical ratio for comparison of percentages and chi-square (Equal Probability and Normal Probability Hypothesis), Interpretation of result

- b) Qualitative Data Analysis: Data Reduction and Classification, Analytical Induction and Constant Comparison.
- c) Research Reporting: Types of Research Report, Format and Bibliography, Evaluation of Research Report, Purpose of research reporting.

Module 3: Internal Assignment:

Credits: 2

Sr. No.	Particulars	Marks
1.	Assignments (2*10)	30
2.	Case study/Projects/Posters and exhibits /Seminar/ Workshop/ Cooperative Learning /Blended Learning/Construction/NaiTalim- Experiential Learning /Open Book Assignment/ Class test	10

Suggested Readings

1. Langenbach, M., Vaughn, C., & Aagaard, L. (1994). An introduction to educational research. Allyn and Bacon. <https://niepid.nic.in/AN%20INTRODUCTION%20TO%20EDUCATIONAL%20RESEARCH.pdf>
2. Kahn, J. V. (1998). Research in Education. Allyn and Bacon. <https://ww2.odu.edu/~jritz/attachments/reined.pdf>
3. Lodico, M. G., Spaulding, D. T., & Voegtler, K. H. (2006). Methods in educational research: From theory to practice. Jossey-Bas. http://stikespanritahusada.ac.id/wp-content/uploads/2017/04/Marguerite_G._Lodico_Dean_T._Spaulding_KatherinBookFi.pdf
4. Campbell, D. T. & Stanley, J. C. (1963). Experimental and Quasi-Experimental Designs for Research.. Chicago: Rand McNally.
5. Garret, H. E. (1958) Statistics in Psychology and Education. New York: Longmans Green and Co. 5th edition
6. Ragin, C. C. (1994) Constructing Social Research: The Unity and Diversity of Method. Pine Forge Press,
7. Strauss, A. and Corbin, J. (1990) Basics of Qualitative Research. Grounded Theory Procedures and Techniques. Newbury Park, CA: Sage.

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1. Fisher, R. A. (1959). Statistical Methods & Scientific Inference. New York: Hafner Publishing.
2. Gay, L.R. (1987). Educational Research, Englewood Cliffs NJ: Macmillan Publishing Company.
3. Kerlinger, F.N. (1964) : Foundations of Behavioural Research (2nd Ed.), Surjeet Publications, New Delhi.
4. Koul, L. (1984): Methodology of Educational Research (2nd Ed.), Vikash Publishing House Pvt. Ltd., New Delhi.
5. Anderson, G (1990): Fundamentals of Educational Research: The Falmer Press, London.
6. Best, J.W. & Kahn, J.V. (1993): Research in Education; 7th Ed. Prentice Hall of India Pvt., Ltd., New Delhi.
7. Kulbir Singh Siddhu (1992), Methodology of Research in Education, Sterling Publishers Private Limited pg, 252



EDUCATIONAL RESEARCH

Unit Structure

- 1.0 Objectives
- 1.1 Introduction
- 1.2 Sources of Acquiring Knowledge
- 1.3 Meaning, Steps and Scope of Educational Research
- 1.4 Scientific Method, aims and characteristics of research as a scientific activity
- 1.5 Ethical considerations in Educational Research
- 1.6 Paradigms of Educational research
- 1.7 Types of Research
 - 1.7.a Fundamental
 - 1.7.b Applied Research
 - 1.7.c. Action Research
- 1.8 Difference between the terms research method and research methodology.
- 1.9 Research Proposal: Its meaning and Components
- 1.10 Let Us Sum Up
- 1.11 Unit End Exercise
- 1.12 References

1.0 OBJECTIVES:

After reading this unit, you will be able to:

- To explain the concept of Educational Research
- To describe the scope of Educational Research
- To state the purpose of Educational Research
- To explain what is scientific enquiry.
- To explain importance of theory development.
- To explain relationship among science, education and educational research.
- To identity fundamental research
- To identity applied research
- To identify action research

- To Differentiate between fundamental, applied, and action research
- To identify different paradigms of research
- Distinguish between research method and research methodology.
- Discuss purposes of research proposal
- List down various components of research proposal
- Prepare write up for research proposal for a given topic.

1.1 INTRODUCTION:

Research purifies human life. It improves its quality. It is search for knowledge. It shows how to solve any problem scientifically. It is a careful enquiry through search for any kind of knowledge. It is a journey from known to unknown. It is a systematic effort to gain new knowledge in any kind of discipline. When it seeks a solution of any educational problem it leads to educational research.

Curiosity, inquisitiveness are natural gifts secured by a man. They inspire him to quest, increase his thirst for knowledge / truth. After trial and error, he worked systematically in the direction of the desired goal. His adjustment and coping with situation make him successful in his task. Thereby he learns something 's, becomes wise and prepares his own scientific procedure while performing the same task for second time. So, is there any relationship among science, education and educational Research?

—Research is the voyage of discovery. It is the quest for answers to unsolved problems.

Research is required in any field to come up with new theories or modify, accept, or nullify the existing theory. From time immemorial it has been seen so many discoveries and inventions took place through research and world has got so many new theories which help the human being to solve his problems. Graham Bell, Thomas Edison, JC Bose, John Dewey, Skinner, Piaget Research like have given us theories which may cause educational progress research needs expertise.

1.2 SOURCES OF ACQUIRING KNOWLEDGE:

From the time we were born and the present day, each one of us has accumulated a body of knowledge. Curiosity, the desire to learn about one's environment and the desire to improve one's life through problem-solving is natural to all human beings. For this purpose, human beings depend on several methods / sources of acquiring knowledge as follows:

1. Learned Authority: Human beings refer to an authority such as a teacher, a parent or the boss or an expert or consultant and seek his / her advice. Such an authority may be based on knowledge or experience or both. For example, if a child has difficulty in learning a particular subject, he / she may consult a teacher. Learned authority could also be a book / dictionary / encyclopedia / journal / web-site on internet.

2. Tradition: Human beings easily accept many of the traditions of their culture or forefathers. For example, in matters of food, dress, communications, religion, home remedies for minor ailments, the way a friend will react to an invitation, one relies on family traditions. On the other hand, students, in case of admission criteria and procedures, examination patterns and procedures, methods of maintaining discipline, co-curricular activities, acceptable manner of greeting teachers and peers rely on school traditions. Long established customs or practices are popular sources of acquiring knowledge. This is also known as tenacity which implies holding on to a perspective without any consideration of alternatives.

3. Experience: Our own prior personal experiences in matters of problem-solving or understanding educational phenomena is the most common, familiar and fundamental source of knowledge.

4. Scientific Method: In order to comprehend and accept learning acquired through these sources, we use certain approaches which are as follows:

(a) Empiricism: It implies relying on what our senses tell us. Through a combination of hearing and seeing we come to know the sound of a train. i.e. through these two senses, we learn to associate specific sounds with specific objects. Our senses also enable us to compare objects / phenomena / events. They provide us with the means for studying and understanding relationships between various concepts (eg. level of education and income).

(b) Rationalism: It includes mental reflection. it places emphasis on ideas rather than material substances. if we see logical interconnectedness between two or more things, we accept those things. For example, we may reason that conducive school / college environment is expected to lead to better teacher performance.

(c) Fideism: It implies the use of our beliefs, emotions or gut reactions including religion. We believe in God because our parents told us though we had not sensed God, seen or heard him nor had concluded that his existence is logically proved.

1.3 MEANING, STEPS AND SCOPE OF EDUCATIONAL RESEARCH:

MEANING OF EDUCATIONAL RESEARCH:

Educational Research as nothing but cleansing of educational Research is nothing but cleansing of educational process. Many experts think Educational Research as under-

According to Mouly, —Educational Research is the systematic application of scientific method for solving for solving educational problem.

Travers thinks, Educational Research is the activity for developing science of behavior in educational situations. It allows the educator to achieve his goals effectively.

According to Whitney, Educational Research aims at finding out solution of educational problems by using scientific philosophical method.

Thus, Educational Research is to solve educational problem in systematic and scientific manner, it is to understand, explain, predict and control human behaviour.

Educational Research Characterizes as follows:

- It is highly purposeful.
- It deals with educational problems regarding students and teachers as well.
- It is precise, objective, scientific and systematic process of investigation.
- It attempts to organize data quantitatively and qualitatively to arrive at statistical inferences.
- It discovers new facts in new perspective. i.e. It generates new knowledge.
- It is based on some philosophic theory.
- It depends on the researcher's ability, ingenuity and experience for its interpretation and conclusions.
- It needs interdisciplinary approach for solving educational problem.
- It demands subjective interpretation and deductive reasoning in some cases.
- It uses classrooms, schools, colleges department of education as the laboratory for conducting researches.

STEPS OF RESEARCH:

The various steps involved in the research process can be summarized as follows;

Step 1: Identifying the Gap in Knowledge

The researcher, on the basis of experience and observation realizes that some students in the class do not perform well in the examination. So, he/she poses an unanswered question: –Which factors are associated with students 'academic performance?

Step 2: Identifying the Antecedent / Causes

On the basis of experience, observation and a review of related literature, he / she realizes that students who are either very anxious or not at all anxious do not perform well in the examination. Thus he / she identifies

anxiety as one of the factors that could be associated with students' academic performance.

Step 3: Stating the Goals

The researcher now states the goals of the study:

1. To ascertain the relationship of anxiety with academic performance of students.
2. To ascertain the gender differences in the anxiety and academic performance of students.
3. To ascertain the gender difference in the relationship of anxiety with academic performance of students.

Step 4: Formulating Hypotheses

The researcher may state his / her hypotheses as follows:

1. There is a significant relationship between anxiety and academic performance of students.
2. There is a significant gender difference in the anxiety and academic performance of students.
3. There is a significant gender difference in the relationship of anxiety with academic performance of students.

Step 5 : Collecting Relevant Information

The researcher uses appropriate tools and techniques to measure anxiety and academic performance of students, selects a sample of students and collects data from them.

Step 6 : Testing the Hypotheses

He / she now uses appropriate statistical techniques to verify and test the hypotheses of the study stated in Step 4.

Step 7 : Interpreting the Findings

He / she interprets the findings in terms of whether the relationship between anxiety and academic performance is positive or negative, linear or curvilinear. He / she finds that this relationship is curvilinear i.e. when a student's anxiety is either very low or very high, his / her academic performance is found to be low. But when a student's anxiety is moderate, his / her academic performance is found to be high.

He / she now tries to explain this finding based on logic and creativity.

Step 8 : Comparing the Findings with Prior researchers' Findings

At this step, the researcher tries to find out whether his / her conclusions match those of the prior researches or not. If not, then the researcher attempts to find out why conclusions do not match with other researches by analyzing prior studies further.

Step 9 : Modifying Theory

On the basis of steps 7 and 8, the researcher speculates that anxiety alone cannot influence academic performance of students. There could be a third factor which influences the relationship between anxiety and academic performance of students. This third factor could be study habits of students. For instance, students who have very low level of anxiety may have neglected their studies throughout the year and hence their academic performance is poor. On the other hand, students who have very high level of anxiety may

not be able to remember what they have learnt or cannot concentrate on studies due to stress or may fall sick very often and hence cannot study properly. Hence their academic performance is poor. However, students with a moderate level of anxiety are motivated enough to study regularly and systematically all through the year and hence their academic performance is high.

Thus, the loosely structured theory on students 'academic performance needs to incorporate one more variable, namely, study habits of students. In other words, it needs to be modified.

Step 10 : Asking New Questions

Do study habits and anxiety interact with each other and influence academic performance of students? i.e. we can now start with a fresh topic of research involving three variables rather than two.

Check your Progress

1. What is the aim of Educational Research?
2. Name the method which is mainly applicable in Educational Research?
3. Which approach is adopted in Educational Research?
4. Name the places which can act as lab oratory for conducting Education Research.

SCOPE OF EDUCATIONAL RESEARCH:

Name of Educational Research changes with the gradual development occurs with respect to knowledge and technology, so Educational Research needs to extend its horizon. Being scientific study of educational process, it involves:

- Individuals (Student, teachers, educational managers, parents.)
- institutions (Schools, colleges, research –institutes)

It discovers facts and relationship in order to make educational process more effective. It relates social sciences like education.

It includes process like investigation, planning (design) collecting data, processing of data, their analysis, interpretation and drawing inferences.

Educational Research

It covers areas from formal education and conformat education as well.

Check your Progress

1. Name disciplines on which education depends.
2. How education is an art?
3. How education is a science?
4. Name the areas of Educational Research in addition to formal education? Name the aspects in which Educational Research can seek improvement?
5. Name the human elements involved in Educational Research?
6. Name the institutions involved in Educational Research?
7. Name the essential qualities of Educational Researches.
8. What is the goal of Educational Research with respect to new knowledge?

Question-1

- (i) to solve education problem
- (ii) scientific method
- (iii) interdisciplinary approach
- (iv) classroom, school, college, department of education.

Question-2

- (v) Philosophy, Psychology, Sociology, History, Economics.
- (vi) Since it imparts knowledge
- (vii) It explains working of human mind/growth, educational program
- (viii) Non-formal education, educational technology.
- (ix) Curriculum, textbooks, teaching methods.
- (x) Teachers, Students, Educational managers, Parents.
- (xi) School, college, research-institutes.
- (xii) Updated knowledge, imagination, insight, scientific attitude.
- (xiii) to generate new knowledge.

1.4 SCIENTIFIC METHOD, AIMS AND CHARACTERISTICS OF RESEARCH AS A SCIENTIFIC ACTIVITY:

RELATIONSHIP AMONG SCIENCE, EDUCATION AND EDUCATIONAL RESEARCH:

Science helps to find out the truth behind the phenomenon. It is an approach to gathering of knowledge rather than mere subject matter. It has following two main functions:

- to develop a theory.
- to deduce hypothesis from that theory.

Scientist uses an empirical approach for data collection and rational approach for development of the theory.

Research shows a way to solve life – problems scientifically. It is a reliable tool for progress of knowledge. Being systematic and methodological, it is treated as a science. It also helps to derive the truth behind the knowledge. It offers methods of improving quality of the process and the product as well. Ultimately, Science and research go hand in hand to find out solution of the problem.

Since Philosophy offers a sound basis to education, Education is considered as an art. However, Scientific progress makes education inclining towards a science rather than an art.

Science belongs to precision and exactness. It suffers hardly from any variable. But education as a social science suffers from many variables, so goes away from exactness. Educational Research tries to make educative process more scientific. But education is softening from multivariable, so it can 't be as exact as physical sciences. If the study is systematically designed to achieve educational goals, it will be educational research. Let us summaries this discussion with Good 's thought –

—If we wish wisdom, we must expect science. If we wish in increase in wisdom, we must expect research ||

Knowledge is educator 's need. Curiosity and thirst for search makes him to follow scientific way wisely. Indirectly, he plays a role

of educational researcher. Ultimately, he is able to solve the educational problem and generate new knowledge. All the three aspects. (Science, education and educational research) have truth as a common basis, More or less, they need exactness and precision. While solving a problem.

AIMS AND CHARACTERISTICS:

An enquiry is a natural technique for a search. But when it 's used systematically and scientifically, it takes the form of a method. So scientific enquiry is also known as Scientific Method.

Bacon 's inductive method contributes to human knowledge. It is difficult to solve many problems either by inductive or by deductive method. So, Charles Darwin seeks happy blending of inductive and deductive method in his scientific method. In this method, initially knowledge gained from previous knowledge, experience, reflective thinking and observation is unorganized. Later on it proceeds inductively from part to whole and particular to general and ultimately to meaningful hypothesis. Thereafter, it proceeds deductively from whole to part, general to particular and hypothesis to logical conclusion.

This method is different from the methods of knowledge – generation like trial and error, experience, authority and intuition. It is a parallel to Dewey 's reflective thinking; because the researcher himself is engrossed in reflective thinking while conducting research.

Scientific method follows five steps as under:

Identification and definition of the problem: The researcher states the identified problem in such a manner that it can be solved through experimentation or observation.

Formulation of hypothesis: It allows to have an intelligent guess for the solution of the problem.

Implication of hypothesis through deductive reasoning: Here, the researcher deduces the implications of suggested hypothesis, which may be true.

Collection and analysis of evidence: The researcher is expected here to test the deduced implications of the hypothesis by collecting concerned evidence related to them through experimentation and observation.

Verification of the hypothesis: Later on, the researcher verifies whether the evidence support hypothesis. If it supports, the hypothesis is accepted, if it doesn't the hypothesis is not accepted and later on it is modified if it is necessary.

A peculiar feature of this method is not to prove the hypothesis as an absolute truth but to conclude that the evidence does or doesn't support the hypothesis.

1.5 ETHICAL CONSIDERATIONS OF RESEARCH:

Research exerts a significant influence over educational systems. Hence a researcher needs to adhere to an ethical code of conduct. These ethical considerations are as follows:

- While a researcher may have some obligations to his / her client in case of sponsored research where the sponsoring agency has given him / her financial aid for conducting the research, he / she has obligations to the users, the larger society, the subjects (sample / respondents) and professional colleagues. He / she should not discard data that can lead to unfavorable conclusions and interpretations for the sponsoring agency.

- The researcher should maintain strict confidentiality about the information obtained from the respondents. No information about the personal details of the respondents should be revealed in any of the records, reports or to other individuals without the respondents 'permission.
- The researcher should not make use of hidden cameras, microphones, tape-recorders or observers without the respondents 'permission. Similarly, private correspondence should not be used without the concerned respondent 's permission.
- In an experimental study, when volunteers are used as subjects, the researcher should explain the procedures completely (eg. the experiment will go on for six months) along with the risks involved and the demands that he / she would make upon the participants of the study (such as the subjects will be required to stay back for one hour after school hours etc.). If possible, the subjects should be informed about the purpose of the experiment / research. While dealing with school children (minors) or mentally challenged students, parents 'or guardians 'consent should be obtained. This phenomenon is known as informed consent '.
- The researcher should accept the fact that the subjects have the freedom to decline to participate or to withdraw from the experiment.

In order to ensure the subjects 'inclusion and continuation in the experiment, the researcher should never try to make undue efforts giving favorable treatment after the experiment, more (additional marks) in a school subject, money and soon.

- In experimental research which may have a temporary or permanent effect on the subjects, the researcher must take all precautions to protect the subjects from mental and physical harm, danger and stress.
- The researcher should make his / her data available to peers for scrutiny.
- The respondents / subjects / participants should be provided with the reasons for the experimental procedures as well as the findings of the study if they so demand.
- The researcher should give due credit to all those who have helped him / her in the research procedure, tool construction, data collection, data analysis or preparation of the research report.
- If at all the researcher has made some promise to the participants, it must be honored and fulfilled.

The idea of social construction of rationality can be pursued by considering Kuhn's idea of scientific paradigm. Thomas Kuhn, himself a historian of science, contributed to a fruitful development in the philosophy of science with his book —The Structure of Scientific Revolutions || published in 1962. It brought into focus two streams of thinking about what could be regarded as scientific, the Aristotelian tradition with its teleological approach and the Galilean with its causal and mechanistic approach. It introduced the concept of paradigm into the philosophical debate.

Definition and Meaning of Paradigm of Research:

“Paradigm” derives from the Greek verb for—exhibiting side by side. In lexica it is given with the translations —example or table of changes in form and differences in form. Thus, Paradigms are ways of organizing information so that fundamental, abstract relationships can be clearly understood.

The idea of paradigm directs attention to science as having recognized patterns of commitments, questions, methods, and procedures that underlie and give direction to scientific work. Kuhn focuses upon the paradigmatic elements of research when he suggests that science has emotional and political as well as cognitive elements. We can distinguish the underlying assumptions of a paradigm by viewing its discourse as having different layers of abstractions. The layers exist simultaneously and are superimposed upon one another.

The concept of paradigm provides a way to consider the divergence in vision, custom, and tradition. It enables us to consider science as having different sets of assumptions, commitments, procedures and theories of social affairs.

A paradigm determines the criteria according to which one selects and defines problems for inquiry and how one approaches them theoretically and methodologically.

A paradigm could be regarded as a cultural manmade object, reflecting the dominant notions about scientific behaviour in a particular scientific community, be it national or international, and at a particular pointing time. Paradigms determine scientific approaches and procedures which stand out as exemplary to the new generation of scientists – as long as they do not oppose them.

A revolution in the world of scientific paradigms occurs when one or several researchers at a given time encounter anomalies or differences, for instance, make observations, which in a striking way do not fit the prevailing paradigm. Such anomalies can give rise to a crisis after which the universe under study is perceived in an entirely new light. Previous theories and facts become subject to thorough rethinking and revaluation.

History of Paradigms of Research:

Educational research faces a particular problem, since education, is not a well-defined, unitary discipline but a practical art. Research into educational problems is conducted by scholars with many disciplinary affiliations. Most of them have a background in psychology or other behavioral sciences, but quite a few of them have a humanistic background in philosophy and history. Thus, there cannot be any prevailing paradigm or normal science⁴ in the very multifaceted field of educational research. However, when empirical research conducted by behavioral scientists, particularly in the Anglo-Saxon countries, in the 1960's and early 1970's began to be accused of dominating research with a positivist quantitatively oriented paradigm that prevented other paradigms of a humanistic or dialectical nature being employed, the accusations were directed at those with a behavioral science background.

During twentieth century two main paradigms were employed in researching educational problems. The one is modeled on the natural sciences with an emphasis on empirical quantifiable observations which lend themselves to analyses by means of mathematical tools. The task of research is to establish causal relationships, to explain. The other paradigm is derived from the humanities with an emphasis on holistic and qualitative information and interpretive approaches.

The two paradigms in educational research developed historically as follows. By the mid-nineteenth century, when August Comte (1798-1857) developed positivism in sociology and John Stuart Mill (1806-1873) empiricism in psychology. They came to serve as models and their prevailing paradigm was taken over by social scientists, particularly in the Anglo-Saxon countries. In European Continent there was another from German idealism and Hegelianism. The —Galilean mechanistic conception became the dominant one particularly with mathematical physics as the methodological ideal.

There are three strands for the other main paradigm in educational research. According to the first strand, Wilhelm Dilthey (1833-1911) maintained that the humanities had their own logic of research and pointed out that the difference between natural sciences and humanities was that the former tried to explain, whereas the latter tried to understand the unique individual in his or her entire, concrete setting.

The second strand was represented by the phenomenological philosophy developed by Edmund Husserl in Germany. It emphasized the importance of taking a widened perspective and of trying to—get to the roots of human activity. The third strandline

Humanistic paradigm consists of the critical philosophy, which developed with certain amount of neo-Marxism.

The paradigm determines how a problem is formulated and methodologically handled. According to the traditional positivist conception, problems related to, for example, to classroom behaviour

should be investigated primarily in terms of the individual actor, either the pupils, who might be neurotic, or the teacher who might be ill prepared for this her job. The other conception is to formulate the problem in terms of the larger setting, that of the school, or rather that of the society at large. By means of such mechanisms as testing, observation and the like, one does not try to find out why the pupil or the teacher deviates from the normal. Rather an attempt is made to study the particular individual as a goal directed human being with particular and unique motives.

Interdependence of the Paradigms:

One can distinguish between two main paradigms in educational research planning and with different basis of knowledge. On one hand there is functional- structural, objective – rational, goal-directed, manipulative, hierarchical, and technocratic approach. On the other hand, there is the interpretive, humanistic, consensual, subjective, and collegial one.

The first approach is derived from classical positivism. The second one, more popular now, partly derived from the critical theory of the Frankfurt school, particularly from Habermas 's theory of communicative action. The first approach is—linear and consists of a straight forward rational action toward preconceived problem. The second approach leaves room for reinterpretation and reshaping of the problem during the process of dialogue prior to action and even during action.

Keeves (1988) argues that the various research paradigms employed in education, the empirical-positivist, the hermeneutic or phenomenological, and the ethnographic-anthropological are complementary to each other. He talks about the —unity of educational research, makes a distinction between paradigms and approaches, and contends that there is, in the final analysis, only one paradigm but many approaches.

For example, the teaching-learning process can be observed and /or video recorded. The observations can be quantified and the data analyzed by means of advanced statistical method. Content can be studied in the light of national traditions, and the philosophy underlying curriculum constructions. Both the teaching-learning process and its outcomes can be studied in a comparative, cross- national perspective.

Depending upon the objective of a particular research project, emphasis is laid more on the one or on the error paradigm. Thus, qualitative and quantitative paradigms are more often than not complementing each other. For example, it is not possible to arrive at any valid information about a school or national system concerning the level of competence achieved in, for instance, science by visiting a number of classrooms and thereby trying to collect impressions. Sample surveys like one collected by IEA (International Association for the Evaluation of Educational Achievement) would be an important tool. But such surveys are not much useful if it comes to accounting for factors behind the differences between school systems. Here the qualitative information of different kinds is required.

Policymakers, planners, and administrators want generalizations and rules which apply to a wide variety of institutions with children of rather diverse backgrounds. The policymaker and planner are more interested in collectivity than in the individual child. They operate from the perspective of the whole system. Whereas, the classroom practitioners are not very much helped by generalizations which apply —on the whole or —by and large because they are concerned with the timely, the particular child here and now.

Need for contemporary approaches:

The behavioural sciences have equipped educational researchers with a store of research tools, such as observational methods and tests, which helps them to systematize observation which would otherwise would not have been considered in the more holistic and intuitive attempts to make, for instance, informal observations or to conduct personal interviews.

Those who turn to social science research in order to find the

—best pedagogy or the most—efficient methods of teaching are in ~~away~~ victims of traditional science which claimed to be able to arrive at generalizations applicable in practically every context. But, through critical philosophy researchers have become increasingly aware that education does not take place in a social vacuum. Educational researchers have also begun to realize that educational practices are not independent of the cultural and social context in which they operate. Nor they are neutral to educational policies. Thus, the two main paradigms are not exclusive, but complementary to each other.

Check your progress:

Answer the following questions.

1. Define the term paradigm?
2. List the two paradigms of research?

1.7 TYPES OF RESEARCH:

1.7A) FUNDAMENTAL RESEARCH:

It is basic approach which is for the sake of knowledge. Fundamental research is usually carried on in a laboratory or other sterile environment, sometimes with animals. This type of research, which has no immediate or planned application, may later result in further research of an applied nature. Basic researches involve the development of theory. It is not concerned with practical applicability and most closely resembles the laboratory conditions and controls usually associated with scientific research. It is concerned establishing generally principles of learning.

For example, much basic research has been conducted with animals to determine principles of reinforcement and their effect on learning. Like

the experiment of skinner on cats gave the principle of conditioning and reinforcement.

According to Travers, basic research is designed to add to an organized body of scientific knowledge and does not necessarily produce results of immediate practical value. Basic research is primarily concerned with the formulation of the theory or a contribution to the existing body of knowledge. Its major aim is to obtain and use the empirical data to formulate, expand or evaluate theory. This type of research draws its pattern and spirit from the physical sciences. It represents a rigorous and structured type of analysis. It employs careful sampling procedures in order to extend the findings beyond the group or situations and thus develops theories by discovering proved generalizations or principles. The main aim of basic research is the discovery of knowledge solely for the sake of knowledge.

Another system for classification is sometimes used for the research dealing with these two types of questions. This classification is based on goal or objective of the research. The first type of research, which has its aim obtaining the empirical data that can be used to formulate, expand or evaluate theory is called basic research. This type of study is not oriented in design or purpose towards the solution of practical problem.

Its essential aim is to expand the frontiers of knowledge without regard to practical application. Of course, the findings may eventually apply to practical problems that have social value.

For example, advances in the practice of medicine are dependent upon basic research in biochemistry and microbiology. Likewise, progress in educational practices has been related to progress in the discovery of general laws through psychological, educational, sociological research.

Check your progress – 1:

Answer the following questions:

1. What is fundamental research?
2. Where can the basic researches be conducted?

1.7 B) APPLIED RESEARCH:

The second type of research which aims to solve an immediate practical problem is referred to as applied research. According to Travers, applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary.

It is research performed in relation to actual problems and under the conditions in which they are found in practice. Through applied research, educators are often able to solve their problems at the appropriate level of complexity, that is, in the classroom teaching learning situations. We may depend upon basic research for the discovery of more general laws of learning, but applied research much is conducted in the order to determine

how these laws operate in the classroom. This approach is essential if scientific changes in teaching practice are to be affected. Unless educators undertake to solve their own practical problems of this type no one else will. It should be pointed out that applied research also uses the scientific method of enquiry. We find that there is not always a sharp line of demarcation between basic and applied research. Certainly, applications are made from theory to help in the solution of practical problems. We attempt to apply the theories of learning in the classroom. On the other hand, basic research may depend upon the findings of the applied research to complete its theoretical formulations. A classroom learning experiment can throw some light on the learning theory. Furthermore, observations in the practical situations serve to test theories and may lead to the formulation of new theories.

Most educational research studies are classified at the applied end of the continuum; they are more concerned with what? works best than with why?. For example, applied research tests the principle of reinforcement to determine their effectiveness in improving learning (e.g. programmed instruction) and behaviour (e.g. behaviour modification). Applied research has most of the characteristics of fundamental research, including the use of sampling techniques and the subsequent inferences about the target population. Its purpose, however, is improving a product or a process – testing theoretical concepts in actual problem situations. Most educational research is applied research, for it attempts to develop generalizations about teaching – learning processes and instructional materials.

The applied research may also be employed a university or research institute or may be found in private industry or working for a government agency. In the field of education such a person might be employed by a curriculum publishing company, a state department of education, or a college of education at a university. Applied researches are also found in the settings in which the application or practitioner 's role is primary. This is where the teachers, clinical psychologists, school psychologists, social workers physicians, civil engineers, managers, advertising specialists and so on are found. Many of these people receive training in doing research, and they use this knowledge for two purposes.

- (1) To help practitioners understand, evaluate, and use the research produced by basic and applied researches in their own fields and,
- (2) To develop a systematic way of addressing the practical problems and questions that arise as they practice their professions.

For example, a teacher who notices that a segment of the class is not adequately motivated in science might look at the research literature on teaching science and then systematically try some of the findings suggested by the research.

Some of the recent focus of applied educational research have been grading practices, collective bargaining for school personnel, curriculum content, instructional procedures, educational technology, and assessment of achievement. The topics have been investigated with applied research

because the questions raised in these areas generally have limited or no concrete knowledge of theory, we can draw upon directly to aid in decision making.

Check your progress – 2:

Answer the following questions:

1. What do you mean by applied research?
2. Applied research be conducted?

1.7C) ACTION RESEARCH:

Research designed to uncover effective ways of dealing with problems in the real world can be referred to as action research.

This kind of research is not confined to a particular methodology or paradigm. For example, a study of the effectiveness of training teenage parents to care for their infants. The study is based on statistical and other evidence that infants of teenage mothers seemed to be exposed to more risks than other infants. The mother and children were recruited for participation in the study while the children were still in neonate period. Mothers were trained at home or in an infant nursery. A controlled group received no training. The mothers trained at home were visited at 2-weeks interval over a 12-month period. Those trained in nursery setting attended 3-days per week for 6 months, were paid minimum wage, and assisted as staff in centre. Results of the study suggested that the children of both group of trained mothers benefited more in terms of their health and cognitive measures than did the controlled children. Generally greater benefits were realized by the children of the mothers trained in the nursery than with the mothers trained at home.

Thus, the study shows that such researches have direct application to real world problems. Second, elements of both quantitative and qualitative approaches can be found in the study. For example, quantitative measure of weight, height, and cognitive skills were obtained in this study. However, at the start itself from the personal impressions and observations without the benefit of systematic quantitative data, the researchers were able to say that the mother in the nursery center showed some unexpected vocational aspirations to become nurses. Third, treatments and methods that are investigated are flexible and might change during the study in response to the results as they are obtained. Thus, action research is more systematic and empirical than some other approaches to innovation and change, but it does not lead to careful controlled scientific experiments that are generalizable to a wide variety of situations and settings.

The purpose of action research is to solve classroom problems through the application of scientific methods. It is concerned with a local problem and is conducted in a local setting. It is not concerned with whether the results are generalizable to any other setting and is not characterized by the same kind of control evidence in other categories of research. The primary goal

of action research is the solution of a given problem, not contribution to science. Whether the research is conducted in one classroom or many classrooms, the teacher is very much a part of the process. The more research trainings the teacher involved have had, the more likely it is that the research will produce valid, if not generalizable research.

The value of action research is confined primarily to those who are conducting it. Despite its shortcomings, it does represent a scientific approach to the problem solving that is considerably better than changed based on the alleged effectiveness of untried procedures, and infinitely better than no changes at all. It is a means by which concerned school personnel can attempt to improve the educational process, at least within their environment. Of course, the true value of action research to true scientific progress is limited. True progress requires the development of sound theories having implications for many classrooms, not just one or two. One sound theory that includes ten principles of learning may eliminate the need of hundreds of would – be action research studies. Given the current status of educational theory, however, action research provides immediate answers to problem that cannot wait for theoretical solutions.

As John Best puts it, action research is focused on immediate applications. Its purposes are to improve school practices and at the same time, to improve those who try to improve the practices, to combine the research processes, habits of thinking, ability to work harmoniously with others, and professional spirit.

If most classroom teachers are to be involved in research activity, it will probably be in the area of action research. Many observers have projected action research nothing more than the application of common sense or good management. Whether or not it is worthy of the term research it does not apply scientific thinking and methods to real life problems and represents a greater improvement over teachers 'subjective judgments and decision based upon stereotype thinking and limited personal experience.

The concept of action research under the leadership of Corey has been instrumental in bringing educational research nearer to educational practitioners. Action research is research undertaken by practitioners in order that they may attempt to solve their local, practical problems by using the method of science.

Check your progress – 3

Answer the following questions:

Q.1 What do you mean by action research?

Q.2 What benefits can teachers get from action research?

1.7 DIFFERENCE BETWEEN THE TERMS RESEARCH METHOD AND RESEARCH METHODOLOGY:

While preparing the design of the study, it is necessary to think of research method. It is simply the method for conducting research. Generally, such methods are divided into quantitative and qualitative methods. Such quantitative methods include descriptive research, evaluation research and assessment research. Assessment type of studies includes surveys, public opinion polls, assessment of educational achievement. Evaluation studies include school surveys, follow up studies. Descriptive research studies are concerned with analysis of the relationships between non manipulated variables. Apart from these quantitative methods, educational research also includes experimental and quasi experimented research, survey research and causal-comparative research.

Qualitative research methods include ethnography, phenomenology, ethno-methodology, narrative research, grounded theory, symbolic interaction and case study.

Thus, the researcher should mention about methods of research used in his research with proper justification for its use.

The term methodology ‘seems to be broader, in the sense it includes nature of population, selection of sample, selection / preparation of tools, collection of data and how data will be analyzed. Here the method of research is also included.

1.8 RESEARCH PROPOSAL: ITS MEANING AND COMPONENTS:

Preparing the research proposal is an important step because at this stage, entire research project gets a concrete shape. Researcher’s insight and inspiration are translated into a step-by-step plan for discovering new knowledge.

Proposal is more than research design. Research design is a subset of proposal. Ordinarily research design will not talk much about theoretical frame work of the study. It will be also silent about the review of related studies. A strong rationale for conducting research is also not part of research design. At the stage of writing proposal, the entire research work shapes into concrete form. In the proposal, the researcher demonstrates that he is familiar with what he is doing.

Following are a few purposes of a research proposal:

- The proposal is like the blue print which the architect designs before construction of a house. It conveys the plan of entire research work along with justification of conducting the same.
- The proposal is to be presented to funding agency or a departmental research committee. Now presentation of research proposal is compulsory before the committee as per U.G.C. guidelines of July

2009. In such a committee, a number of experts participate and suggest important points to help and guide researcher. In fact, this is a very constructive activity. In C.A.S.E., a research proposal is presented on three occasions. First, in the researcher's forum on Saturday, second in Tuesday seminar and finally before the committee consisting of Dean, Head, Guide and other experts. Such fruitful discussion helps in resolving many issues. When such presentation is there, it always brings seriousness on the part of researcher and guide also. During such presentation, strengths and limitations of proposal will be come out. Funding agency also provides funds based on strength and quality of proposal.

- Research proposal serves as a plan of action. It conveys researcher and others as to how study will be conducted. There is indication of time schedule and budget estimates in the proposal which guides researcher to complete the task in time with in sanctioned budget.
- The proposal approved by committee serves as a bond of agreement between researcher and guide. Entire proposal becomes a mirror for both to execute the study further.

Thus, a research proposal serves mainly following purposes.

- (i) It communicates researcher's plan to all others interested.
- (ii) It serves as a plan of action.
- (iii) It is an agreement between researcher and the guide.
- (iv) Its presentation before experts provides further rethinking on the entire work.

Following components are generally included in the research proposal. It is not necessary to follow this list rigidly. It should provide useful outline for writing of any research proposal.

Normally, a research proposal begins with an Introduction, this gives clearly the background or history of the problem selected. Some also calls this as a theoretical / conceptual framework. This will include various theories / concepts related to problem selected. Theoretical frame work should have logical sequence. Suppose researcher wants to study the achievement of class IX students in mathematics in particular area, then conceptual frame may include:

- Objectives of teaching mathematics, its purpose of secondary school level
- Importance of achievement in mathematics
- Level of achievement as studied by other researchers
- Factors affecting achievements of mathematics

- Various commissions and committees' views on achievement in mathematics.

All these points can be put into sequence logically. Whenever needed theoretical support be given. This is an important step in research proposal. Generally, any proposal begins with this type of introduction.

A. Identification of Research Topic: Sources and Need:

As discussed earlier, researcher will spell out as to how the problem emerged, its social and educational context and its importance to the field. Some researchers name this caption as background of the study or Theoretical / Conceptual frame work of the study. In short, here the entire topic of the research is briefly introduced along with related concepts and theories in the field.

B. Review of Related Literature:

In this section, one presents what is so far known about the problem under investigation. Generally theoretical / conceptual frame work is already reported in earlier section. In this section researcher concentrates on studies conducted in the area of interest. here, a researcher will locate various studies conducted in his area and interest. Try to justify that all such located studies are related to your work. For locating such studies, one will refer following documents / sources.

- Surveys of research in education (Edited earlier by Prof. M. B. Buch and Later on by NCERT, New Delhi)
- Ph. D. Theses available in various libraries.
- Current Index to Journals in Education (CIJE)
- Dissertation Abstract International (DAI)
- Educational Resources Information Centre (ERIC) by U.S. office of education.
- Various national / International journals, Internet resources (For detail see Ary, D., Jacobs, L.C., and Razavieh A. (1972). Introduction to Research in Education N. Y. Holt, Rinehart and Winston, INC pp 55 –70)

In research proposal, the review of studies conducted earlier is reported briefly. There are two ways of reporting the same. One way could be all such related studies be reported chronologically in brief indicating purpose, sample, tools and major findings. Of course, this will increase the volume of research proposal. Second studies with similar trends be put together and its important trend/s be highlighted. This is bit difficult, but innovative. Normally in review the surname of author and year in bracket is mentioned. There is also a trend to report studies conducted in other countries separately. It is left to guide and researcher whether such separate caption is necessary or not.

At the end of review, in research proposal, there should be conclusion. (Of course, a separate caption like conclusion be avoided.)

Here, the researcher shares the insights he has gained from the review. Also, on the basis of review he will justify the need of conducting present study. The researcher should conclude with following points:

- What has been done so far in this area?
- Where? (Area wise)
- When? (Year wise)
- How? (Methodology wise)
- What needs to be done?

Thus, the researcher will identify the Research Gap ‘.

C. Rationale and Need of the Study:

Rationale should answer the question – why ‘this study is conducted? It why ‘is answered properly, then rationale a strong one. For strong rationale, the earlier section of review will be of much help. Identified research gaps will convey as to why this study is conducted. Suppose the investigator wants to study the following problem: Development and Try out of CAI in Teaching of Science for Class VIII in Mumbai..

Here, the researcher should try to answer why CAI only? Why it is in science teaching only? Why it is for class VIII only? Why it is in Mumbai only?

If these questions are answered adequately, then rationale becomes strong. Here one has to identify gaps in the area of science teaching especially with reference to CAI. Apart from this, the need for conducting the present study be justified.

D. Definition of Terms:

Every research study involves certain key or technical terms which have some special connotation in the context of study; hence it is always desirable to define such key words. There are two types definitions, (i) Theoretical / constitutive and (ii) Operational.

A constitutive definition elucidates a term and perhaps gives some more insight into the phenomena described by the terms. Thus, this definition is based on some theory. While an operational definition is one which ascribes meaning to a concept by specifying the operations that must be performed in order to measure the concept, e.g. the word achievement ‘has many meanings but operationally it can be defined as, —the scores obtained by the students in English test constructed by researcher in 2009. Here it is clear that achievement in English will be measured by administering to test constructed by Mr. So and so in 2009. Apart from

operational definitions, one can define some terms which have definite meaning with reference to particular investigation. The terms like Lok Jumbish, Minimum Levels of Learning, Programmed Learning etc. can be define in particular context of research.

E. Variables:

Variables involved in the research need to be identified here. Their operational definitions should be given in the research proposal. Especially in study where experimental research is conducted, variables be specified with enough care. Their classification should be done in terms and dependent variables, independent variables, intervening variables, extraneous variables etc. Controlling of some variables need to be discussed at an appropriate stage in proposal.

F. Research questions objectives and hypotheses:

While reading the statement of the problem, there may be bit confusion to avoid such confusions there is a need to have specification of a research problem. This specification can be done by writing research questions, objectives, hypotheses, by writing operational definitions thus, objectives give more clarity to researchers and reactors objectives are the foundations of the research, as they will guide the entire process of research. List of objectives should not be too lengthy not ambiguous. The objectives we stated clearly to indicate what the researcher is trying to investigate.

While conducting any research, researcher would definitely aim at assuring certain questions. The researcher should frame such questions in a praise way. Some researchers simply put the objectives in the question form, which is just duplication of objectives, which be avoided.

Depending on the nature of study, the researcher would formulate hypotheses, The proposition of a hypothesis is derived from theoretical constructs, previous researches on earlier researches, the researcher can write research or will hypothesis will be more suitable however as per evidences from previous researches one can decide the nature of hypothesis.

Formulation of hypothesis is an indication that researcher has sufficient knowledge in the area and it also gives direction for data collection and analysis. A hypothesis has to be:

(I) testable, (ii) have explanatory power, (iii) state expected relationship between variables. (iv) consistent with existing body of knowledge.

G. Assumptions:

Best and Kahn (2004) assumptions are statements of what the researcher believes to be facts but cannot verify. If the researcher is proceeding with certain assumptions, then same need to be reported in the research proposal.

H. Scope, Limitations and Delimitations:

In any research, it is not possible to cover all aspects of the area of interest, variables, population and so on. Thus, a study has always certain limitations. Limitations are those conditions beyond the control of the researcher that may play restriction on conclusions. Sometimes, the tool used is not revalidated. This itself becomes limitation of the study. Thus, limitation is a broad term, but delimitation is a narrow term. It indicates boundaries of the study. The study on achievement in English can be delimited to only grant- in-aid school, which includes schools who follow Maharashtra State Board, **so here beyond this conclusion cannot be extended.** This can be made more specific by specifying the population and sample.

I. Method, Sample and Tools:

Method: A researcher should report about method of research. As discussed in (b), researcher should mention as to how study will be conducted. Depending on nature of study – qualitative or quantitative the method of research needs to be reported along with justification. i.e. how particular method suits one 's study be discussed in brief. If it is survey, do not write simply survey, but indicate further the type of survey too. If it is experimental design, mention specifically which type of experimental design.

Sample: You might have already studied about sampling in details. This section of research proposal will mention about selection of sample. First, the researcher should mention about would like too in for. One must describe the population along with total size. This is especially needed in case of randomization and stratification. Researcher should mention about probability non probability sampling design. Accordingly, selection of sample needs to be detailed out along with its justification. Many researchers write about randomization without mentioning size of population. the researcher also writes about stratified sampling without details of various strata along with its size. As from the sample statistics, population parameter is to be estimated, solution of sample be done with enough care.

In case of qualitative research, investigator may go for theoretical sampling. It is necessary to derailed out have, it need be, description of field is necessary.

Tools: You have already shared about various tools of data collection. In this section of proposal selection and description of tool is for be reported with proper justification. Steps of construction of particular tool need to be reported in brief. If readymade tools are used then its related details need to be reported. Details like author of the tool, its reliability, validity, and norms, along with scoring procedure need to be reported. It has been found that many researchers fail to report the year when tool was constructed. As far as possible, very old tools need to be avoided. In case of readymade tools, always look for which population it was desirable to use valid and reliable tools.

J. Significance of the Study:

If we have already reported strong rationale then, hardly there is any need to go for significance. In rationale part, one must describe as to how this study will contribute to the field of education. How the findings / results of particular research will influence educational process in general need to be reported in the rationale only.

(Note: There are various models for writing research proposal. It differs from university to university. Many funding agencies have their own format for proposal.)

K. Technique/s of Data Analysis:

This is crucial step in proposal. As to how collected data will be tabulated and organized for the purpose of further analysis is to

be reported in this section. If it is quantitative research, parametric or non-parametric statistical techniques will be used need to be reported. Before applying any technique for data analysis, verify the needed assumptions about that particular technique. Suppose if one wants to go for ANOVA, verify about assumption for normality, nature of data – especially in interval or ratio scale, homogeneity of variances and randomization. If it is qualitative analysis, detailed out about nature of data, its tabulation, organisation and description. If data are to be analyzed with the help of content analysis, how exactly it will be done needs to be detailed out. Whichever technique one is using, it needs to be in tune with objectives and hypotheses of study.

L. Bibliography:

During preparation of proposal, researcher consults various sources like books, journals, reports, Ph.D. theses etc. All such primary / secondary sources need to be reported in the bibliography. Generally American Psychological Association – Publication Manual be followed to write references. All authors quoted in proposal need to be listed in bibliography. Authors who are not quoted but they are useful for further reading be also listed. Consistency and uniformity be observed in reporting references.

M. Time Frame:

The proposal submitted for M.Phil or Ph.D. degrees, generally do not require time frame in all universities, but there is a fixed limit for these courses. It is always advisable to give detailed schedule if research work, as it helps to keep researcher alert. Proposals to be submitted to funding agency definitely ask for time frame. Time frame need to be reported keeping following points in view. Time / duration mentioned by funding agency be properly dividend.

- Time required for preliminary work like review of literature.
- Time required for preparing tool/s.

- Time requires for data collection, field visits etc.
- Time required for data analysis and report writing.

N. Budget:

The proposal submitted to the funding agency needs details regarding financial estimates. It may include expected expenditure keeping various budget needs. Following budget needs be kept in view along with amount.

- Remuneration for project team, i.e. principal investigator and project team.
- Remuneration for secretarial staff like clerk, data entry operator, accountants, helpers etc.
- Remuneration for appointing project fellow, field investigators etc.
- Expenditure towards purchase of books, journals, tools etc.
- Expenditure towards Printing, Xeroxing, Stationery etc.
- Expenditure for data entry, tabulation and analysis of data.
- Expenditure for field work, travel for monitoring purpose etc.
- Expenditure for preparing final report.

While preparing budget, examine the guidelines given by particular funding agency.

O. Chapterisation:

Generally, scheme of chapterisation is given in synopsis. If at all it is to be reported in research proposal write down various

caption, sub captions in each chapter, format for thesis is given by few universities, same be followed.

Check Your Progress

- Select one topic for research in education and write a various steps of research proposal at length.

1.10 LET US SUM UP

- Educational Research is systematic application of scientific method for solving educational problems, regarding students and teachers as well.
- Results democratic education are slow and sometimes defective. So it needs Educational Research to solve educational problems.
- Educational Research involves individuals like teachers / students and educational institutions. It covers areas from formal education to non-formal education.

- Educational Research solves educational problems, purifies educative process and generates new knowledge.
- Scientific enquiry / Scientific method is happy blending of Inductive and deductive method. Initially it proceeds from part to whole to state meaningful hypothesis. Later on, it proceeds from whole to part and hypothesis to logical conclusion.
- A theory is general explanation of phenomenon. It can be refined and modified as factual knowledge. It is developed on the basis of results of scientific method.
- Fundamental Research is basic research which is for the sake of knowledge. Applied research to solve an immediate practical problem.
- Action research seeks effective way to solve a problem of the concerned area without using a particular methodology / paradigm. Paradigm of research is way to select, define and solve the problem method.

1.11 UNIT END EXERCISE

- 1 What is meant by Educational Research?
- 2 What is the need of Educational Research?
- 3 What is its scope?
- 4 State the purpose of Education Research?
- 5 What are the steps of scientific enquiry /method?
- 6 Explain how scientific method relates theory development?
- 7 What is theory? What are the principles to be considered while stating a theory?
- 8 Explain the relationship among Science, Education and Educational Research?
- 9 Why do we need a conduct fundamental research?
- 10 In which situations can applied research be conducted?
- 11 How is action research different from the other types?
- 12 What benefits can teachers get from action research?
- 13 How the paradigms are dependent on each other illustrate?

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RESEARCH DESIGN

Unit Structure:

- 2.0 Objectives
- 2.1 Introduction
- 2.2 Meaning, Definition, Purpose and Components of research design.
- 2.3 Concept of Universe/Population, sample and sampling
- 2.4 Need for sampling
- 2.5 Advantages and Disadvantages of sampling
- 2.6 Characteristics of a good sample
- 2.7 Techniques of sampling
- 2.8 Types of probability sampling
- 2.9 Types of Non-probability sampling
- 2.10 Review of related Research- Purpose, Need and Organization
- 2.11 Let us sum up
- 2.12 Unit End Exercise

2.0 OBJECTIVES:

After learning of this unit, you will be able to :

- State meaning of research design
- Describe purpose of research design
- Components of Research Design
- Define universe, sample and sampling
- State the need of sampling
- List the advantages and disadvantages of sampling
- State the characteristics of a good sample
- Differentiate between techniques of sampling
- Explain types of probability & Non- probability sampling

2.1 INTRODUCTION:

The researcher is concerned with the generalizability of the data beyond the sample. For studying any problem it is impossible to study the entire population. It is therefore convenient to pick out a sample out of the

universe proposed to be covered by the study. The process of sampling makes it possible to draw valid inferences or generalizations on the basis of careful observation of variables within a small proportion of the population.

2.2 MEANING, DEFINITION, PURPOSE AND COMPONENTS OF RESEARCH DESIGN

Meaning of Research Design :Before starting a research, the investigator will look for problem, he will read books, journals, research reports and other related literature. Based on this, he will finalize the topic for research. During this process, he will be in close contact with his guide. As soon as the topic is decided, first task is to decide about design.

Research design is a blue print or structure with in which research is conducted. It constitutes the blue print for the collection, measurement and analysis of data.

According to Gay and Airasian (2000),—A design is general strategy for conducting a research study. The nature of the hypothesis, the variables involved, and the constraints of the real world all contribute to the selection of design.

Kothari (1988) says,— Decisions regarding WHAT?, WHERE?, WHEN?, HOW MUCH?, by WHAT? means concerning an inquiry or a research study constitute research design.

Thus, it can be said that research design is an outline of what the researcher will do from writing of objectives, hypotheses and its operational implications to find analysis of data. Research design should be able to convey following :

- What is the study about?
- Where will study be carried out?
- What type of data is necessary?
- Where necessary data is available?
- How much time is needed to complete the study?
- What will be the sampling design?
- Which tools will be identified to collect data?
- How data will be analysed?

Depending upon the types of research the structure of design may vary. Suppose, one is conducting an experimental research, then identification of variables, control of variables, types of experimental design etc. be discussed properly. If someone is conducting qualitative research, then one should stress on understanding of setting, nature of data, holistic approach, selection of participants, inductive data analysis. Thus, according to nature and type of study the components of design will be decided.

In short, any efficient research design will help the researcher to carry out the study in a systematic way.

PURPOSE OF RESEARCH DESIGN:

- A research design helps the investigator to obtain answers to research problem and issues involved in the research, since it is the outline of entire research process.
- Design also tells us about how to collect data, what observation are to be carry out, how to make them, how to analyse the data.
- Design also guides investigator about statistical techniques to be used for analysis.
- Design also guides to control certain variables in experimental research.

Thus, design guides the investigator to carry out research step by step in an efficient way. The design section is said to be complete / adequate if investigator could carry out his research by following the steps described in design.

COMPONENTS OF RESEARCH DESIGN:

The components of the research design will depend upon the type of research design you choose. But following are the common components of a research design:

- Purpose statement
- Techniques for collecting data
- Methods of analyzing the data
- Type of research methodology
- Possible challenges to conducting research
- Setting of research study
- Timeline
- Measurement of analysis

2.3 CONCEPT OF UNIVERSE/ POPULATION, SAMPLE AND SAMPLING:

Universe or Population : It refers to the totality of objects or individuals regarding which inferences are to be made in a sampling study.

Or

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

First, the population is selected for observation and analysis.

Sample : It is a collection consisting of a part or **subset** of the objects or individuals of population which is selected for the purpose, representing the population sample obtained by collecting information only about some members of a population.

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

2.4 NEED FOR SAMPLING

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

2.5 ADVANTAGES AND DISADVANTAGES OF SAMPLING:

Advantages of Sampling :

- **Economical :** Manageable sample will reduce the cost compare to entire population.
- **Increased speed :** The process of research like collection of data, analysis and Interpretation of data etc take less time than the population.
- **Greater Scope :** Handling data becomes easier and manageable in case of a sample. Moreover comprehensive scope and flexibility exists in the case of a sample.
- **Accuracy :** Due to limited area of coverage, completeness and accuracy is possible. The processing of data is done accurately producing authentic results.
- **Rapport :** Better rapport is established with the respondents, which helps in validity and reliability of the results.

Disadvantages of Sampling :

- **Biasedness :** Chances of biased selection leading to erroneous conclusions may prevail. Bias in the sample may be due to faulty method of selection of individuals or the nature of phenomenon itself.
- **Selection of true representative sample :** If the problem under study is of a complex nature, it becomes difficult to select a true representative sample, otherwise results will not be accurate & will be usable.

- **Need for specialized knowledge :** The researcher needs knowledge, training and experience in sampling technique, statistical analysis and calculation of probable error. Lack of those may lead to serious mistakes.
- **Changeability of units :** If the units of population are not homogeneous, the sampling technique will be unscientific. At times, all the individuals may not be accessible or may be uncooperative. **In such a case**, they have to be replaced. This introduces a change in the subjects to be studied.
- **Impossibility of sampling :** Sometimes population is too small or too **heterogeneous** to select a representative sample. In such cases 'census study' is the alternative (Information about each member of the population) Sampling error also comes because of expectation of high standard of accuracy.

2.6 CHARACTERISTICS OF A GOOD SAMPLE:

A good sample should possess **the** following characteristics

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

2.7 TECHNIQUES OF SAMPLING:

There are different types of **sampling techniques** based on two factors viz. (1) the representation basis and (2) the element selection technique on the representation basis. **The** sample may be probability sampling or it may be non-probability sampling. On the element basis, the sample may be either unrestricted or restricted. Here we will discuss about two types of sampling viz.

- Probability Sampling and
- Non-Probability Sampling.

Difference between Probability and Non- Probability Sampling :

(1) A probability sample is one in which each member of the population has an equal chance of being selected but in a non- probability sample, a particular member of the population being chosen is unknown.

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

2.8 TYPES OF PROBABILITY SAMPLING:

Following are the types of probability sampling

- 1) Simple random sampling
- 2) Systematic sampling
- 3) Stratified sampling
- 4) Cluster sampling
- 5) Multi stage sampling

Simple Random Sampling :In this all members have the same chance (probability) of being selected. Random method provides an unbiased cross selection of the population. For Example, we wish to draw a sample of 50 students from a population of 400 students. Place all 400 names in a container and draw out 50 names one by one.

Systematic Sampling :Each member of the sample comes after an equal interval from its previous member.

one student out of every eight students in the population. The starting

Cluster Sampling (Area Sampling) : A researcher selects sampling units at random and then does complete observation of all units in the group. For example, **your research involves kindergarten** schools. Select randomly 15 schools. Then study all the children of 15 schools. In cluster sampling the unit of sampling consists of multiple cases. It is also known as area sampling, as the selection of individual member is made on the basis of place residence or employment.

Multistage Sampling :The sample to be studied is **selected** at random at different stages. For example, **we need to select a sample of middle class working couples in Maharashtra** state. The first stage will be randomly **selecting a specific number of** districts in a state. The second stage involves selecting randomly a specific number of rural

and urban areas for the study. At the third stage, from each area, a specific number of middle class families will be Selected and at the last stage, working couples will be selected from these families.

2.9 TYPES NON-PROBABILITY SAMPLING:

The following are techniques of non-probability sampling:

- a) Purposive Sampling
- b) Convenience Sampling
- c) Quota Sampling
- d) Snowball Sampling

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

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

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

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

2.10 REVIEW OF RELATED LITERATURE

PURPOSE AND NEED FOR REVIEW OF RELATED LITERATURE:

- Familiarize with the current state of knowledge and research on the topic.
- Provide foundation and context to the research topic.
- Identify the areas of prior scholarship to avoid duplicating the study and give due credit to the researchers.
- Develop the theoretical framework and methodology.
- Identify the gaps in research and justify the need for your research.

- Establish the relationship of your work in the context of the area of research and other research studies.

Different ways to organize review related literature

CHRONOLOGICAL (by date): This is one of the most common ways, especially for topics that have been talked about for a long time and have changed over their history. Organise it in stages of how the topic has changed: the first definitions of it, then major time periods of change as researchers talked about it, then how it is thought about today.

BROAD-TO-SPECIFIC: Another approach is to start with a section on the general type of issue you're reviewing, then narrow down to increasingly specific issues in the literature until you reach the articles that are most specifically similar to your research question, thesis statement, hypothesis, or proposal. This can be a good way to introduce a lot of background and related facets of your topic when there is not much directly on your topic but you are tying together many related, broader articles.

MAJOR MODELS or MAJOR THEORIES: When there are multiple models or prominent theories, it is a good idea to outline the theories or models that are applied the most in your articles. That way you can group the articles you read by the theoretical framework that each prefers, to get a good overview of the prominent approaches to your concept.

PROMINENT AUTHORS: If a certain researcher started a field, and there are several famous people who developed it more, a good approach can be grouping the famous author/researchers and what each is known to have said about the topic. You can then organise other authors into groups by which famous authors' ideas they are following. With this organisation it can help to look at the citations your articles list in them, to see if there is one author that appears over and over.

CONTRASTING SCHOOLS OF THOUGHT: If you find a dominant argument comes up in your research, with researchers taking two sides and talking about how the other is wrong, you may want to group your literature review by those schools of thought and contrast the differences in their approaches and ideas.

How to structure and write your literature review

- Consider possible ways of organizing your literature review:
 - Chronological, ie. by date of publication or trend
 - Thematic
 - Methodological
- Use Cooper's taxonomy to explore and determine what elements and categories to incorporate into your review

- Revise and proofread your review to ensure your arguments, supporting evidence and writing is clear and precise.

2.11 LET US SUM UP

In this unit we discussed the concept of population, sample and sampling. Need of sampling advantages and disadvantages of sampling were discussed and also Characteristics of a good sample are elaborated. In the second part, the types of probability and non-probability sampling were detailed.

2.12 UNIT END EXERCISE

Q.1 Define the following

- (a) Sample
- (b) Sampling

Q.2 Write short note for the following.

- (a) Need for sampling
- (b) Advantages of sampling
- (c) Disadvantages of sampling
- (d) Characteristics of a good sample

Q.3 Differentiate between probability and non-probability sampling.

Q.4 Discuss the types of probability sampling.

Q.5 Discuss the types of non-probability sampling.

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VARIABLES AND HYPOTHESES

Unit Structure

- 3.0 Objectives
- 3.1 Introduction
- 3.2 Meaning of variables
- 3.3 Types of variables (independent, dependent, Extraneous, Intervening and Moderator)
- 3.4 Controlling Extraneous and Intervening Variables
- 3.5 Concept of hypothesis
- 3.6 Sources of hypothesis
- 3.7 Types of hypotheses (Research, Directional, Non-Directional, Null, Statistical and question form)
- 3.8 Formulating hypothesis
- 3.9 Characteristics of a good hypothesis
- 3.10 Hypothesis testing and theory
- 3.11 Errors in testing of hypothesis
- 3.12 Summary

3.0 OBJECTIVES:

After reading this unit you will be able to:

- Define variables
- Identify the different types of variables
- Show the relationship between the variables
- Explain the concept of hypotheses
- State the sources of hypotheses
- Explain different types of hypotheses
- Identify types of hypotheses
- Frame hypotheses skillful
- Describe the characteristics of a good hypothesis
- Explain the significance level in hypothesis testing
- Identify the errors in testing of hypothesis

3.1 INTRODUCTION:

Each person/thing we collect data on is called an **observation** (in our research work these are usually people/subjects). Observation (participants) possess a variety of **characteristics**. If a characteristic of an observation (participant) is the same for every member of the group **i.e.** it does **not** vary, it is called a **constant**. If a characteristic of an observation (participant) differs for group members it is called a **variable**. In research we do **not** get excited about constants (since everyone is the same on that characteristic); we are more interested in **variables**.

3.2 MEANING OF VARIABLES

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

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

Variables are properties or characteristics of some event, object, or person that can take on different values or amounts.

Variables are things that we measure, control, or manipulate in research. They differ in many respects, most notably in the role they are given in our research and in the type of measures that can be applied to them.

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

Let us analyse an example; if a researcher is interested in the effects of two different teaching methods on the science achievement of fifth-grade students, the grade level is constant, because all individuals involved are fifth-graders. This characteristic is the same for everyone; it is a 'constant' condition of the study.

After the different teaching methods have been implemented, the fifth-graders involved would be measured with a science achievement test. It is very unlikely that all of the fifth-graders would receive the same score on this test, **hence** the score on the science achievement test becomes a variable, because different individuals will have different scores; at least, not all individuals will have the same scores. We would say that science achievement is a variable, but we would mean, specifically, that the score on the science achievement test is a variable.

There is another variable in the **preceding** example – the teaching method. In contrast to the science achievement test score, which undoubtedly would be measured on a scale with many possible values, teaching method is a categorical variable consisting of only two categories, the two methods. **Thus**, we have different kinds of variables and different names or classifications for them.

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

3.3 TYPES OF VARIABLES:

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

3.3.1 Independent variables:

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

3.3.2 Dependent variables:

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

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

The following example further illustrates the use of variables and constants. In a study conducted to determine the effect of three different teaching methods on achievement in elementary algebra, each of three

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

The terms dependent and independent variable apply mostly to experimental research where some variables are manipulated, and in this sense, they are "independent" from the initial reaction patterns, features, intentions, etc. of the subjects. Some other variables are expected to be "dependent" on the manipulation or experimental conditions. That is to say, they depend on "what the subject will do" in response. Somewhat contrary to the nature of this distinction, these terms are also used in studies where we do not literally manipulate independent variables, but only assign subjects to "experimental groups" based on some pre-existing properties of the subjects. Independent variables are those that are manipulated whereas dependent variables are only measured or registered.

Consider other examples of independent and dependent variables:

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

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

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

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

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

Dependent variable: Score on a professional attitude inventory.

3.3.3 Extraneous variable:

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

result of extraneous variable(s) is technically described as an ‘experimental error’. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

E.g. Effectiveness of different methods of teaching Social Science.

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

3.3.4 Intervening variables:

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

Eg. “Effect of immediate reinforcement on learning the parts of speech”.

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

3.3.5 Moderator:

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

For example, suppose that the researcher designs a study to determine the impact of the lengths of reading passages on the comprehension of the reading passage. The design has three levels of passage length: 100 words, 200 words, and 300 words. The participants in the study are fourth-fifth- and sixth-graders.

Suppose that the three grade levels all did very well on the 100- word passage, but only the sixth-graders did very well on the 300- word passage. This would mean that successfully comprehending reading passages of different lengths was moderated by grade level.

Check your progress:

1. What is a Variable?
2. Identify the variables in this example “Teaching effectiveness of secondary school teachers in relation to their characteristics”.

3.4 CONTROLLING EXTRANEOUS AND INTERVENING VARIABLES

All experimental designs have one central characteristic: they are based on manipulating the independent variable and measuring the effect on the dependent variable. Experimental designs result in inferences drawn from the data that explain the relationships between the variables.

The classic experimental design consists of the experimental group and the control group. In the experimental group the independent variable is manipulated. In the control the dependent variable is measured when no alteration has been made on the independent variable. The dependent variable is measured in the experimental group the same way, and at the same time, as in the control group.

The prediction is that the dependent variable in the experimental group will change in a specific way and that the dependent variable in the control group will not change.

Controlling Unwanted Influences:

To obtain a reliable answer to the research question, the design should eliminate unwanted influences. The amount of control that the researcher has over the variables being studied varies, from very little in exploratory studies to a great deal in experimental design, but the limitations on control must be addressed in any research proposal.

These unwanted influences stem from one or more of the following: extraneous variables, bias, the Hawthorne effect, and the passage of time.

Extraneous Variables :

Extraneous variables are variables that can interfere with the action of the independent variable. Since they are not part of the study, their influence must be controlled.

In the research literature, the extraneous variables also referred to as intervening variables, directly affect the action of the independent variable on the dependent variables. Intervening variables are those variables that occur in the study setting. They include economic, physical, and psychological variables. Therefore, it is important to control extraneous variables to study the effect of independent variable on dependent variable. We must be very careful to control all possible extraneous variables that might intervene the dependant variable.

Methods of controlling extraneous variables include :

- randomization
- homogeneous sampling techniques
- matching
- building the variables into the design
- statistical control

Randomization : Theoretically, randomization is the only method of controlling all possible extraneous variables. The random assignment of subjects to the various treatment and control groups means that the groups can be considered statistically equal in all ways at the beginning of the experiment. It does not mean that they actually are equal for all variables.

However, the probability of their being equal is greater than the probability of their not being equal, if the random assignment was carried out properly. The exception lies with small groups where random assignment could result in unequal distribution of crucial variables. If this possibility exists, the other method would be more appropriate. In most instances, however, randomization is the best method of controlling extraneous variables.

A random sampling technique results in a normal distribution of extraneous variables in the sample; this approximates the distribution of those variables in the population. The purpose of randomization is to ensure a representative sample.

Randomization comes into play when we randomly assign subjects to experimental and control groups, thus ensuring that the groups are as equivalent as possible prior to the manipulation of the independent variable. Random assignment assures that the researcher is unbiased. Instead, assignment is predetermined for each subject.

Homogeneous Sample :One simple and effective way of controlling an extraneous variable is not to allow it to vary. We may choose a sample that is homogenous for that variable. For example, if a researcher believes that gender of the subject might affect the dependant variable, he/she could select the subjects of the desired gender only. If the researcher believes that socio- economic status might influence the dependant variable, he/she would select subject from a particular range of socio-economic status. After selecting students from a homogenous population the researcher may assign the subjects to experimental and control group randomly.

Matching :When randomization is not possible, or when the experimental groups are too small and contain some crucial variables, subjects can be matched for those variables. The experimenter chooses subjects who match each other for the specified variables. One of these matched subjects is assigned to the control group and the other to the experimental group, thus ensuring the equality of the groups at the outset.

The process of matching is time consuming and introduces considerable subjectivity into sample selection. Therefore, it should be avoided whenever possible. If we use matching, limit the number of groups to be matched and keep the number of variables for which the subjects are matched low. Matching with more than five variables becomes extremely cumbersome, and it is almost impossible to find enough matched partners for the sample. Matching may be used in all research designs when we are looking at certain outcomes and want to have as much control as possible.

Building Extraneous Variables into the Design :When extraneous variables cannot be adequately controlled by randomization, they can be built into the design as independent variables. They would have to be added to the purpose of study and tested for significance along with other variables. In this way, their effect can be measured and separated from the effect of the independent variable.

Statistical Control :In experimental designs, the effect of the extraneous variables can be subtracted statistically from the total action of the variables. The technique of analysis of covariance (ANCOVA) may be used for this purpose. Here, one or more extraneous variables are measured along with the dependant variables. This method adds to the cost of the study because of the additional data collection and analysis required. Therefore, it should be used only as a last resort.

Methods of controlling intervening variables:

Since the intervening variables cannot be observed during the experiment, it is not easy to control them. They need to be controlled statistically while analyzing the data. To control the effects of these variables, the researcher sometimes may have to identify and measure them and measure the dependent variable being studied and statistically reduce or minimize the effect of the intervening variable.

3.5 CONCEPT OF HYPOTHESIS

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

3.5.1 Meaning:

The word **Hypothesis** (plural is **hypotheses**) is derived from the Greek word – ‘hypotithenai’ meaning ‘to put under’ or ‘to suppose’ for a hypothesis to be put forward as a **scientific hypothesis**, the scientific method requires that one can test it.

Etymologically hypothesis is made up of two words, “hypo”(less than) and “thesis”, which mean less than or less certain than a thesis. It is the presumptive statement of a proposition or a reasonable guess, based upon the available evidence, which the researcher seeks to prove through his study.

According to Lundberg, —A hypothesis is a tentative generalization, the validity of which remains to be tested. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea, which becomes the basis for action or investigation.

Goode and Hatthave defined it as—a proposition which can be put to test to determine its validity. A hypothesis is a statement temporarily accepted as true in the light of what is, at the time, known about a phenomenon, and it is employed as a basis for action in the search of new truth.

A hypothesis is a tentative assumption drawn from knowledge and theory which is used as a guide in the investigation of other facts and theories that are yet unknown.

It is a guess, supposition or tentative inference as to the existence of some fact, condition or relationship relative to some phenomenon which serves to explain such facts as already are known to exist in a given area of research and to guide the search for new truth.

Hypotheses reflect the research worker's guess as to the probable outcome of the experiments.

A hypothesis is therefore a shrewd and intelligent guess, a supposition, inference, hunch, provisional statement or tentative generalization as to the existence of some fact, condition or relationship relative to some phenomenon which serves to explain already known facts in a given area of research and to guide the search for new truth on the basis of empirical evidence. The hypothesis is put to test for its tenability and for determining its validity.

In this connection Lundberg observes: Quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable. For example, consider statements like the following ones: “Students who receive counseling will show a greater increase in creativity than students not receiving counseling” or “There is a positive relationship between academic aptitude scores and scores on a social adjustment inventory for high school students”

These are hypotheses capable of being objectively verified and tested. Thus, we may conclude that a hypothesis states what we are looking for and it is a proposition which can be put to a test to determine its validity.

3.5.2 Importance of the Hypotheses:

The importance of hypotheses is generally recognized more in the studies which aim to make predictions about some outcome. In experimental research, the researchers is interested in making predictions about the outcome of the experiment or what the results are expected to show and therefore the role of hypotheses is considered to be of utmost importance. In the historical or descriptive research, on the other hand, the researcher is investigating the history of a city or a nation, the life of a man, the

happening of an event, or is seeking facts to determine the status quo of some situation and thus may not have a basis for making a prediction of results. A hypothesis, therefore, may not be required in such fact-finding studies. Hillway (1964) too is of the view that “when fact-finding alone is the aim of the study, a hypothesis may not be required.”

Most historical or descriptive studies, however, involve not only fact-finding but interpretation of facts to draw generalizations. If a researcher is tracing the history of an educational institution or making a study about the results of a coming assembly poll, the facts or data he gathers will prove useful only if he is able to draw generalizations from them. Whenever possible, a hypothesis is recommended for all major studies to explain observed facts, conditions or behaviour and to serve as a guide in the research process. The importance of hypotheses may be summarized as under.

1. Hypotheses facilitate the extension of knowledge in an area. They provide tentative explanations of facts and phenomena, and can be tested and validated. It sensitizes the investigator to certain aspects of situations which are relevant from the standpoint of the problem in hand.
2. Hypotheses provide the researcher with rational statements, consisting of elements expressed in a logical order of relationships which seek to describe or to explain conditions or events, that have not yet been confirmed by facts. The hypotheses enable the researcher to relate logically known facts to intelligent guesses about unknown conditions. It is a guide to the thinking process and the process of discovery. It is the investigator's eye – as or to guiding light in the work of darkness.
3. Hypotheses provide direction to the research. It defines what is relevant and what is irrelevant. The hypotheses tell the researcher specifically what he needs to do and find out in his study. Thus, it prevents the review of irrelevant literature and the collection of useless or excess data. Hypotheses provide a basis for selecting the sample and the research procedures to be used in the study. The statistical techniques needed in the analysis of data, and the relationships between the variables to be tested, are also implied by the hypotheses. Furthermore, the hypotheses help the researcher to delimit his study in scope so that it does not become broad or unwieldy.
4. Hypotheses provide the basis for reporting the conclusions of the study. It serves as a framework for drawing conclusions. The researcher will find it very convenient to test each hypothesis separately and state the conclusions that are relevant to each. On the basis of these conclusions, he can make the research report interesting and meaningful to the reader. It provides the outline for setting conclusions in a meaningful way.

Hypothesis has a very important place in research although it occupies a very small place in the body of a thesis. It is almost impossible for a research worker not to have one or more hypotheses before proceeding with his work.

3.6 SOURCES OF HYPOTHESIS:

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

What is the source of hypotheses? They may be derived directly from the statement of the problem; they may be based on the research literature, or in some cases, such as in ethnographic research, they may (at least in part) be generated from data collection and analysis. The various sources of hypotheses may be:

- Review of similar studies in the area or of the studies on similar problems;
- Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;
- Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution.
- Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.
- Intuition is often considered a reasonable source of research hypotheses -- especially when it is the intuition of a well-known researcher or theoretician who “knows what is known”
- Rational Induction is often used to form “new hypotheses” by logically combining the empirical findings from separate areas of research
- Prior empirical research findings are perhaps the most common source of new research hypotheses, especially when carefully combined using rational induction
- Thus hypothesis are formulated as a result of prior thinking about the subject, examination of the available data and material including related studies and the council of experts.

Check your progress:

1. Define hypothesis.
2. Hypothesis is stated in researches concerned with?
3. What are the sources of hypotheses?

3.7 TYPES OF HYPOTHESIS:

3.7.1 Research hypothesis: When a prediction or a hypothesized relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. Usually a research hypothesis must contain, at least, one independent and one dependent variable. A research hypothesis must be stated in a testable form for its proper evaluation. As already stressed, this form should indicate a relationship between the variables in clear, concise, and understandable language. Research hypotheses are classified as being directional or non-directional.

3.7.2 Directional hypothesis: The hypotheses which stipulate the direction of the expected differences or relationships are termed as directional hypotheses. For example, the research hypothesis: “There will be a positive relationship between individual’s attitude towards high caste Hindus and his socio-economic status,” is a directional research hypothesis. This hypothesis stipulates that individual with favorable attitude towards high caste Hindus will generally come from higher socio-economic Hindu families and therefore it does stipulate the direction of the relationship. Similarly, the hypothesis: “Adolescent boys with high IQ will exhibit low anxiety than adolescent boys with low IQ” is a directional research hypothesis because it stipulates the direction of the difference between groups.

3.7.3 Non-directional hypothesis: A research hypothesis which does not specify the direction of expected differences or relationships is a non-directional research hypothesis. For example, the hypotheses: “There will be difference in the adaptability of fathers and mothers towards rearing of their children” or “There is a difference in the anxiety level of adolescent girls of high IQ and low IQ” are non-directional research hypotheses. Although these hypotheses stipulate there will be a difference, the direction of the difference is not specified. A research hypothesis can take either statistical form, declarative form, the null form, or the question form.

3.7.4 Statistical hypothesis: When it is time to test whether the data support or refute the research hypothesis, it needs to be translated into a statistical hypothesis. A statistical hypothesis is given in statistical terms. Technically, in the context of inferential statistics, it is a statement about one or more parameters that are measures of the populations under study. Statistical hypotheses often are given in quantitative terms, for example: “The *mean* reading achievement of the population of third-grade students taught by Method A equals the *mean* reading achievement of the population taught by Method B.” Therefore, we can say that **statistical hypotheses** are, concerned with populations under study. We use inferential statistics, to draw conclusions

about population values even though we have access to only a sample of participants. In order to use inferential statistics, we need to translate the research hypothesis into a testable form, which is called the null hypothesis. An alternative or declarative hypothesis indicates the situation corresponding to when the null hypothesis is not true. The stated hypothesis will differ depending on whether or not it is a directional research hypothesis.

3.7.5 Declarative hypothesis: When the researcher makes a positive statement about the outcome of the study, the hypothesis takes the declarative form. For example, the hypothesis: “The academic achievement of extroverts is significantly higher than that of the introverts,” is stated in the declarative form. In such a statement of hypothesis, the researcher makes a prediction based on his theoretical formulations of what should happen if the explanations of the behaviour he has given in his theory are correct.

3.7.6 Null hypothesis: In the null form, the researcher makes a statement that no relationship exists. The hypothesis, “There is no significant difference between the academic achievement of high school athletes and that of non-athletes,” is an example of null hypothesis. Since null hypotheses can be tested statistically, they are often termed as statistical hypotheses. They are also called the testing hypotheses when declarative hypotheses are tested statistically by converting them into null form. It states that even where it seems to hold good it is due to mere chance. It is for the researcher to reject the null hypothesis by showing that the outcome mentioned in the declarative hypothesis does occur and the quantum of it is such that it cannot be easily dismissed as having occurred by chance.

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

- The declarative form of the hypothesis might be: “Teaching children through the programmed instruction material will decrease their test anxiety”.
- The null form would be: “teaching children through programmed instruction material will have no effect on their test anxiety.’ This statement shows that no relationship exists between programmed instruction and test anxiety.
- The question form puts the statement in the form: “Will teaching children through programmed instruction decrease their test anxiety?”

3.8 FORMULATING HYPOTHESIS:

Hypotheses are guesses or tentative generalizations, but these guesses are not merely accidents. Collection of factual information alone does not lead to successful formulation of hypotheses. Hypotheses are the products of considerable speculation and imaginative guess work. They are based partly on known facts and explanations, and partly conceptual. There are no precise rules for formulating hypotheses and deducing consequences from them that can be empirically verified.

However, there are certain necessary conditions that are conducive to their formulation. Some of them are:

- *Richness of background knowledge.* A researcher may deduce hypotheses inductively after making observations of behaviour, noticing trends or probable relationships. For example, a classroom teacher daily observes student behaviour. On the basis of his experience and his knowledge of behaviour in a school situation, the teacher may attempt to relate the behaviour of students to his own, to his teaching methods, to changes in the school environment, and so on. From these observed relationships, the teacher may inductively formulate a hypothesis that attempts to explain such relationships.

Background knowledge, however, is essential for perceiving relationships among the variables and to determine what findings other researchers have reported on the problem under study. New knowledge, new discoveries, and new inventions should always form continuity with the already existing corpus of knowledge and, therefore, it becomes all the more essential to be well versed with the already existing knowledge.

Hypotheses may be formulated correctly by persons who have rich experiences and academic background, but they can never be formulated by those who have poor background knowledge.

- *Versatility of intellect:* Hypotheses are also derived through deductive reasoning from a theory. Such hypotheses are called deductive hypotheses. A researcher may begin a study by selecting one of the theories in his own area of interest. After selecting the particular theory, the researcher proceeds to deduce a hypothesis from this theory through symbolic logic or mathematics. This is possible only when the researcher has a versatile intellect and can make use of it for restructuring his experiences. Creative imagination is the product of an adventure, sound attitude and agile intellect. In the hypothesis's formulation, the researcher works on numerous paths. He has to take a consistent effort and develop certain habits and attitudes. Moreover, the researcher has to saturate himself with all possible information about the problem and then think liberally at it and proceed further in the conduct of the study.

- *Analogy and other practices:* Analogies also lead the researcher to clues that he might find useful in the formulation of hypotheses and for finding solutions to problems. For example, suppose a new situation

resembles an old situation in regard to a factor X. If the researcher knows from previous experience that the old situation is related to other factors Y and Z as well as to X, he reasons that perhaps a new situation is also related to Y and Z. The researcher, however, should use analogies with caution as they are not fool proof tools for finding solutions to problems. At times, conversations and consultations with colleagues and expert from different fields are also helpful in formulating important and useful hypotheses.

3.9 CHARACTERISTICS OF A GOOD HYPOTHESIS

Hypothesis must possess the following characteristics:

- i) Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
- ii) Hypothesis should be capable of being tested. Some prior study may be done by researcher in order to make hypothesis at testable one. A hypothesis “is testable if other deductions can be made from it which, in turn, can be confirmed or disproved by observation.”
- iii) Hypothesis should state relationship between variables, if it happens to be a relational hypothesis.
- iv) Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and he should develop such hypotheses.
- v) Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.
- vi) Hypothesis should be consistent with most known facts i.e. it must be consistent with a substantial body of established facts. In other words, it should be one which judge accept as being the most likely.
- vii) *The hypotheses selected should be amenable to testing within a reasonable time.* The researcher should not select a problem which involves hypotheses that are not agreeable to testing within a reasonable and specified time. He must know that there are problems that cannot be solved for a long time to come. These are problems of immense difficulty that cannot be profitably studied because of the lack of essential techniques or measures.
- viii) Hypothesis must explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition. Thus, hypothesis must actually explain what it claims to explain, it should have empirical reference.

1. What are the different types of hypotheses?
2. List the characteristics of hypothesis.

3.10 HYPOTHESIS TESTING AND THEORY

When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design.

Research in which the independent variable is manipulated is termed 'experimental hypothesis – testing research' and research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research'.

Let us get acquainted with relevant terminologies used in hypothesis testing.

Null hypothesis and alternative hypothesis:

In the context of statistical analysis, we often talk about null hypothesis and alternative hypothesis. If we are to compare method A with method B about its superiority and if we proceed on the assumption that both methods are equally good, then this assumption is termed as the null hypothesis. As against this, we may think that the method A is superior or the method B is inferior, we are then stating what is termed as alternative hypothesis. The null hypothesis is generally symbolized as H_0 and the alternative hypothesis as H_a . The null hypothesis and the alternative hypothesis are chosen before the sample is drawn. Generally, in hypothesis testing we proceed on the basis of null hypothesis, keeping the alternative hypothesis in view. Why so? The answer is that on the assumption that null hypothesis is true, one can assign the probabilities to different possible sample results, but this cannot be done if we proceed with the alternative hypothesis. Hence the use of null hypothesis (at times also known as statistical hypothesis) is quite frequent.

a) **The level of significance:** This is very important concept in the context of hypothesis testing. It is always some percentage (usually 5%) which should be chosen with great care, thought and reason. In case we take the significance level at 5 per cent, then this implies that H_0 will be rejected when the sampling result (i.e. observed evidence) has a less than 0.05 probability of occurring if H_0 is true. In other words, the 5 percent level of significance means that researcher is willing to take as much as a 5 percent risk of rejecting the null hypothesis when it (H_0) happens to be true. Thus, the significance level is the maximum value of the probability of rejecting H_0 when it is true and is usually determined in advance before testing the hypothesis.

b) **The criteria for rejecting the null hypothesis** may differ. Sometimes the null hypothesis is rejected only when the quantity of the outcome is so large that the probability of its having occurred by mere chance is 1 time out of 100. We consider the probability of its having

occurred by chance to be too little and we reject the chance theory of the null hypothesis and take the occurrence to be due to a genuine tendency. On other occasions, we may be bolder and reject the null hypothesis even when the quantity of the reported outcome is likely to occur by chance 5 times out of 100. Statistically the former is known as the rejection of the null hypothesis at 0.1 level of significance and the latter as the rejection at 0.5 level. It may be pointed out that if the researcher is able to reject the null hypothesis, he cannot directly uphold the declarative hypothesis. If an outcome is not held to be due to chance, it does not mean that it is due to the very cause and effect relationship asserted in the particular declarative statement. It may be due to something else which the researcher may have failed to control.

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

d) **Two-tailed and One-tailed tests:** In the context of hypothesis testing, these two terms are quite important and must be clearly understood. A two-tailed test rejects the null hypothesis if, say, the sample mean is significantly higher or lower than the hypothesized value of the mean of the population. Such a test is appropriate when the null hypothesis is some specified value and the alternative hypothesis is a value not equal to the specified value of the null hypothesis. In a two-tailed test, there are two rejection regions, one on each tail of the curve which can be illustrated as under:

If the significance level is 5 per cent and the two-tailed test is to be applied, the probability of the rejection area will be 0.05 (equally divided on both tails of the curve as 0.025) and that of the acceptance region will be 0.95

But there are situations when only one-tailed test is considered appropriate. A one-tailed test would be used when we are to test, say, whether the population mean is either lower than or higher than some hypothesized value. We should always remember that accepting H_0 , on the basis of sample information does not constitute the proof that H_0 is true. We only mean that there is no statistical evidence to reject it.

3.11 ERRORS IN TESTING OF HYPOTHESIS

Type I and Type II errors: in the context of testing of hypotheses, there are basically two types of errors we can make. We may reject H_0 when H_0 is true and we may accept H_0 when in fact H_0 is not true. The former is known as Type I error and the latter as Type II error. In other words, Type

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

Table 3.1	Decision	
	Accept H_0	Reject H_0
H_0 (true)	Correct decision	Type I error (α error)
H_0 (false)	Type II error (β error)	Correct decision

The probability of Type I error is usually determined in advance and is understood as the level of significance of testing the hypothesis. If type I error is fixed at 5 per cent, it means that there are about 5 chances in 100 that we will reject H_0 when H_0 is true.

We can control Type I error just by fixing it at a lower level. For instance, if we fix it at 1 per cent, we will say that the maximum probability of committing Type I error would only be 0.01.

But with a fixed sample size, n , when we try to reduce Type I error, the probability of committing Type II error increases. Both types of errors cannot be reduced simultaneously. There is a trade-off between two types of errors which means that the probability of making one type of error can only be reduced if we are willing to increase the probability of making the other type of error. To deal with this trade-off in business situations, decision-makers decide the appropriate level of Type I error by examining the costs or penalties attached to both types of errors. If Type I error involves the time and trouble of reworking a batch of chemicals that should have been accepted, whereas Type II error means taking a chance that an entire group of users of this chemical compound will be poisoned, then in such a situation one should prefer a Type I error to a Type II error. As a result, one must set very high level for Type I error in one's testing technique of a given hypothesis. Hence, in the testing of hypothesis, one must make all possible effort to strike an adequate balance between Type I and Type II errors.

Check your progress:

1. Explain the term level of significance?
2. What are the two types of error in the testing of the hypothesis?

3.12 LET US SUM UP

It is important for the researcher to formulate hypotheses before data are gathered. This is necessary for an objective and unbiased study. It should be evident from what you have read so far that in order to carry out

research; you need to start by identifying a question which demands an answer, or a need which requires a solution. The problem can be generated either by an initiating idea, or by a perceived problem area. We also studied that there are important qualities of hypotheses which distinguish them from other forms of statement. A good hypothesis is a very useful aid to organizing the research effort. It specifically limits the enquiry to the interaction of certain variables; it suggests the methods appropriated for collecting, analyzing and interpreting the data; and the resultant confirmation or rejection of the hypothesis through empirical or experimental testing gives a clear indication of the extent of knowledge gained. The hypothesis must be conceptually clear. The concepts utilized in the hypothesis should be clearly defined – not only formally but also, if possible, operationally.

Hypothesis testing is the often-used strategy for deciding whether a sample data offer such support for a hypothesis that generalization can be made. Thus, hypothesis testing enables us to make probability statements about population parameter(s).

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QUANTITATIVE AND QUALITATIVE RESEARCH-I

Unit Structure

4A.0 Objectives

4A.1 A) Quantitative Research – Concept

4A.1 B) Qualitative Research – Concept

4A.2 Nature of Descriptive Research

4A.3 Correlational Research

4A.4 Causal-Comparative Research

4A.5 Document Analysis

4A.6 Ethnography

4A.7 Case Study

4A.8 Analytical Method

4A.9 Survey Research

4A.10 References

4A.0 OBJECTIVES:

After reading this unit, the student will be able to:

- (a) State the nature of descriptive research
- (b) Explain how to conduct correlational research
- (c) Explain how to conduct correlational research
- (d) Explain how to conduct causal-comparative research
- (e) Explain how to conduct case study research
- (f) Explain the concept of documentary research
- (g) Explain how to conduct ethnographic research
- (h) Explain the concept of analytical research
- (i) Explain difference between qualitative and quantitative research.
- (j) Explain the concept of survey research

4A.1A) QUANTITATIVE RESEARCH-CONCEPT:

Quantitative research is the process of collecting and analyzing numerical data. It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations.

Quantitative research is the opposite of qualitative research, which involves collecting and analyzing non-numerical data (e.g. text, video, or audio).

Quantitative research is widely used in the natural and social sciences: biology, chemistry, psychology, economics, sociology, marketing, etc.

4A.1 B) QUALITATIVE RESEARCH -CONCEPT:

Qualitative research involves collecting and analyzing non-numerical data (e.g., text, video, or audio) to understand concepts, opinions, or experiences. It can be used to gather in-depth insights into a problem or generate new ideas for research.

Qualitative research is the opposite of quantitative research, which involves collecting and analyzing numerical data for statistical analysis.

Qualitative research is commonly used in the humanities and social sciences, in subjects such as anthropology, sociology, education, health sciences, history, etc.

4A.2 NATURE OF DESCRIPTIVERESEARCH:

The descriptive research attempts to describe, explain and interpret conditions of the present i.e. what is? The purpose of a descriptive research is to examine a phenomenon that is occurring at a specific place(s) and time. A descriptive research is concerned with conditions, practices, structures, differences or relationships that exist, opinions held, processes that are going on or trends that are evident.

Types of Descriptive Research Methods

In the present unit, the following descriptive research methods are described in detail:

1. Correlational Research
2. Causal-Comparative Research
3. Analytical Method
4. Survey Research

4A.3 CORRELATIONAL METHOD:

Correlational research describes what exists at the moment (conditions, practices, processes, structures etc.) and is therefore, classified as a type of descriptive method. Nevertheless, these conditions, practices, processes or

structures described are markedly different from the way they are usually described in a survey or an observational study.

Correlational research comprises of collecting data to determine whether, and to what extent, a relationship exists between two or more quantifiable variables. Correlational research uses numerical data to explore relationships between two or more variables. The degree of relationship is expressed in terms of a coefficient of correlation. If the relationship exists between variables, it implies that scores on one variable are associated with or vary with the scores on another variable. The exploration of relationship of the relationship between variables provides insight into the nature of the variables themselves as well as an understanding of their relationships. If the relationships are substantial and consistent, they enable a researcher to make predictions about the variables.

Correlational research is aimed at determining the nature, degree and direction of relationships between variables or using these relationships to make predictions. Correlational studies typically investigate a number of variables expected to be related to a major, complex variable. Those variables which are not found to be related to this major, complex variable are omitted from further analysis. On the other hand, those variables which are found to be related to this major, complex variable are further analysed in a causal-comparative or experimental study so as to determine the exact nature of the relationship between them.

In a correlational study, hypotheses or research questions are stated at the beginning of the study. The null hypotheses are often used in a correlational study.

Correlational study does not specify cause-and-effect relationships between variables under consideration. It merely specifies concomitant variations in the scores on the variables. For example, there is a strong relationship between students' scores on academic achievement in Mathematics and their scores on academic achievement in Science. This does not suggest that one of these variables is the cause and the other is the effect. In fact, a third variable, viz., students' intelligence could be the cause of students' academic achievement in both, Mathematics and Science.

Steps of a Correlation Research

1. Selection of a Problem: Correlational study is designed (a) to determine whether and how a set of variables are related, or

(b) to test the hypothesis of expected relationship between among the set of two or more variables. The variables to be included in the study need to be selected on the basis of a sound theory or prior research or observation and experience. There has to be some logical connection between the variables so as to make interpretations of the findings of the study more meaningful, valid and scientific. A correlational study is not done just to find out what exists: it is done for the ultimate purpose of explanation and prediction of phenomena. If a correlational study is done just to find out

what exists, it is usually known as a shot gun ‘approach and the findings of such a study are very difficult to interpret.

2. **Selection of the Sample and the Tools:** The minimum acceptable sample size should be 30, as statistically, it is regarded as a large sample. The sample is generally selected using one of the acceptable sampling methods. If the validity and the reliability of the variables to be studied are low, the measurement error is likely to be high and hence the sample size should be large. Thus it is necessary to ensure that valid and reliable tools are used for the purpose of collecting the data. Moreover, suppose you are studying the relationship between classroom environment and academic achievement of students. If your tool measuring classroom environment focuses only on the physical aspects of the classroom and not its psycho-social aspects, then your findings would indicate a relationship only between academic achievement of students and the physical aspects of the classroom environment and not the entire classroom environment since the physical aspects of the classroom environment is not the only comprehensive and reliable measure of classroom environment. Thus, the measurement instruments should be valid and reliable.

3. **Design and Procedure:** The basic design of a correlational study is simple. It requires scores obtained on two or more variables from each unit of the sample and the correlation coefficient between the paired scores is computed which indicates the degree and direction of the relationship between variables.

4. **Interpretation of the Findings:** In a study designed to explore or test hypothesized relationships, a correlation coefficient is interpreted in terms of its statistical significance.

Co relational research is of the following two types:

(a) **Relationship Studies:** These attempt to gain insight into variables that are related to complex variables such as academic performance, self-concept, stress, achievement motivation or creativity.

(b) **Prediction Studies:** These are conducted to facilitate decisions about individuals or to aid in various types of selection. They are also conducted to determine predictive validity of measuring tools as well as to test variables hypothesized to be predictors of a criterion variable.

Some questions that could be examined through correlation research are as follows:

1. How is job satisfaction of a teacher related to the extent of autonomy available in job?
2. Is there a relationship between Socio-Economic Status of parents and their involvement with the school?
3. How well do Common Entrance Test Scores for admission to B.Ed. reflect / predict teacher effectiveness?

- (a) State the meaning of correlational research.
- (b) Explain the steps of correlational research.

4A.4 CAUSAL-COMPARATIVE RESEARCH:

It is a type of descriptive research since it describes conditions that already exist. It is a form of investigation in which the researcher has no direct control over independent variable as its expression has already occurred or because they are essentially non-manipulable. It also attempts to identify reasons or causes of pre-existing differences in groups of individuals i.e. if a researcher observes that two or more groups are different on a variable, he tries to identify the main factor that has led to this difference. Another name for this type of research is *ex post facto* research (which in Latin means —after the fact) since both the hypothesized cause and the effect have already occurred and must be studied in retrospect.

Causal-comparative studies attempt to identify cause-effect relationships, correlational studies do not. Causal-comparative studies involve comparison, correlational studies involve relationship. However, neither method provides researchers with true experimental data. On the other hand, causal-comparative and experimental research both attempt to establish cause-and-effect relationships and both involve comparisons. In an experimental study, the researcher selects a random sample and then randomly divides the sample into two or more groups. Groups are assigned to the treatments and the study is carried out. However, in causal-comparative research, individuals are not randomly assigned to treatment groups because they already were selected into groups before the research began. In experimental research, the independent variable is manipulated by the researcher, whereas in causal-comparative research, the groups are already formed and already different on the independent variable.

Inferences about cause-and-effect relationships are made without direct intervention, on the basis of concomitant variation of independent and dependent variables. The basic causal-comparative method starts with an effect and seeks possible causes. For example, if a researcher observes that the academic achievement of students from different schools. He may hypothesize the possible cause for this as the type of management of schools, viz. private-aided, private-unaided, or government schools (local or state or any other). He therefore decides to conduct causal-comparative research in which academic achievement of students is the effect that has already occurred and school types by management is the possible hypothesized cause. This approach is known as *retrospective causal-comparative research* since it starts with the effects and investigates the causes.

In another variation of this type of research, the investigator starts with a cause and investigates its effect on some other variable.

i.e. such research is concerned with the question what is the effect of X on Y when X has already occurred? 'For example, what long-term effect has occurred on the self-concept of students who are grouped according to ability in schools? Here, the investigator hypothesizes that students who are grouped according to ability in schools are labeled brilliant ' , average 'or dull' and this over a period of time could lead to unduly high or unduly poor self-concept in them. This approach is known as **prospective causal-comparative research** since it starts with the causes and investigates the effects. However, retrospective causal-comparative studies are far more common in educational research.

Causal-comparative research involves two or more groups and one independent variable. The goal of causal-comparative research is to establish cause-and-effect relationships just like an experimental research. However, in causal-comparative research, the researcher is able to identify past experiences of the subjects that are consistent with a treatment 'and compares them with those subjects who have had a different treatment or no treatment. The causal-comparative research may also involve a pre-test and a post-test. For Instance ,are searcher wants to compare the effect of Environmental Education in the B.Ed. syllabus on student-teachers 'awareness of environmental issues and problems attitude towards environmental protection. Here, a researcher can develop and administer a pre-test before being taught the paper on —Environmental Education || and post-test after being taught the same. At the same time, the pre-test as well as the post-test are also administered to a group which was not taught the paper on Environmental Education. This is essentially a non-experimental research as there is no manipulation of the treatment although it involves a pre-test and a post-test. In this type of research, the groups are not randomly assigned to exposure to the paper on Environmental Education. Thus, it is possible that other variables could also affect the outcome variables. Therefore, in a causal-comparative research, it is important to think whether differences other than the independent variable could affect the results.

In order to establish cause-and-effect in a causal-comparative research, it is essential to build a convincing rational argument that the independent variable is influencing the dependent variable. It is also essential to ensure that other uncontrolled variables do not have an effect on the dependent variable. For this purpose, the researcher should try to draw a sample that minimizes the effects of other extraneous variables. According to Picciano, instating a hypothesis in a causal comparative study, the word effect is frequently used.

Conducting a Causal-Comparative Study

Although the independent variable is not manipulated, there are control procedures that can be exercised to improve interpretation of results.

Design and Procedure

The researcher selects two groups of participants, accurately referred to as *comparison groups*. These groups may differ in two ways as follows:

- (i) One group possesses a characteristic that the other does not.
- (ii) Each group has the characteristic, but to differing degrees or amounts.
- (iii) Definition and selection of the comparison groups are very important parts of the causal-comparative procedure.
- (iv) The independent variable differentiating the groups must be clearly and operationally defined, since each group represents a different population.
- (v) In causal-comparative research the random sample is selected from two already existing populations, not from a single population as in experimental research.
- (vi) As in experimental studies, the goal is to have groups that are as similar as possible on all relevant variables except the independent variable.
- (vii) The more similar the two groups are on such variables, the more homogeneous they are on everything but the independent variable.

Control Procedures

- Lack of randomization, manipulation, and control are all sources of weakness in a causal-comparative study.
- Random assignment is probably the single best way to try to ensure equality of the groups.
- A problem is the possibility that the groups are different on some other important variable (e.g. gender, experience, or age) besides the identified independent variable.

Matching

- Matching is another control technique.
- If a researcher has identified a variable likely to influence performance on the dependent variable, the researcher may control for that variable by *pair-wise matching* of participants.
- For each participant in one group, the researcher finds a participant in the other group with the same or very similar score on the control variable.
- If a participant in either group does not have a suitable match, the participant is eliminated from the study.
- The resulting matched groups are identical or very similar with respect to the identified extraneous variable.

- The problem becomes serious when the researcher attempts to simultaneously match participants on two or more variables.

Comparing Homogeneous Groups or Subgroups

- To control extraneous variables, groups that are homogeneous with respect to the extraneous variable are compared.
- This procedure may lower the number of participants and limit the generalizability of the findings.
- A similar but more satisfactory approach is to form subgroups within each group that represent all levels of the control variable.
- Each group might be divided into two or more subgroups on the basis of high, average, and low levels of ‘Independent variable’.
- Suppose the independent variable in the study is students ‘IQ. The subgroups then will comprise of high, average, and low levels of IQ. The existence of comparable subgroups in each group controls for IQ.
- In addition to controlling for the variable, this approach also permits the researcher to determine whether the independent variable affects the dependent variable differently at different levels of the control variable.
- The best approach is to build the control variable right into the research design and analyze the results in a statistical technique called factorial analysis of variance.
- A factorial analysis allows the researcher to determine the effect of the independent variable and the control variable on the dependent variable both separately and in combination.
- It permits determination of whether there is interaction between the independent variable and the control variable such that the independent variable operates differently at different levels of the control variable.

Independent variables in causal-comparative research can be of following types:

<u>Type of Variable</u>	<u>Examples</u>
Organismic Variables	Age
	Gender
	Religion
	Caste
Ability Variables	Intelligence

	Scholastic Ability
	Specific Aptitudes
Personality Variables	Anxiety Level
	Stress-proneness
	Aggression Level
	Emotional Intelligence
	Introversion / Extroversion
	Self-Esteem
	Self-Concept
	Academic or Vocational Aspirations
	Brain Dominance
	Learning, Cognitive or Thinking Styles
	Psycho-Social Maturity
Home Background Related Variables	Home Environment
	Socio-Economic Status
	Educational Background of Parents
	Economic Background of Parents
	Employment Status of Parents
	Single Parent v/s Both Parents
	Employment Status of Mother (Working or Non- Working)
	Birth Order
	No. of Siblings
School Related Variables	School Environment
	Classroom Environment
	Teacher Personality
	Teaching Style
	Leadership Style
	School Type by Management (Private-aided v/s Private-unaided v/s Government)
	School Type by Gender(Single-sex v/s Co- educational)

	School Type by Denomination (Run by a non- religious organisation v/s Run by a religious organisation whose one of the objectives is to propagate a specific religion.)
	School Type by Board Affiliation (SSC, CBSE, ICSE, IB, IGCSE)
	School Size
	Per Student Expenditure
	Socio-Economic Context of the School

The Value of Causal-Comparative Research: In a large majority of educational research especially in the fields of sociology of education and educational psychology, it is not possible to manipulate independent variables due to ethical considerations especially when one is dealing with variables such as anxiety, intelligence, home environment, teacher personality, negative reinforcement, equality of opportunity and so on. It is also not possible to control such variables as in an experimental research. For studying such topics and their influence on students, causal-comparative method is the most appropriate.

The Weaknesses of Causal-Comparative Research: There are three major limitations of causal-comparative research. These include, (a) lack of control or the inability to manipulate independent variables methodologically, (b) the lack of power to assign subjects randomly to groups and (c) the danger of inappropriate interpretations. The lack of randomization, manipulation, and control factors make it difficult to establish cause-and-effect relationships with any degree of confidence.

The statistical techniques used to compare groups in a causal- comparative research include the t-test when two groups are to be compared and ANOVA when more than two groups are to be compared. The technique of ANCOVA may also be used in case some other variables likely to influence the dependent variable need to be controlled statistically. Sometimes, chi square is also used to compare group frequencies, or to see if an event occurs more frequently in one group than another.

Use of Analysis of Covariance (ANCOVA): It is used to adjust initial group differences on variables used in causal- comparative and experimental research studies. Analysis of covariance adjusts scores on a dependent variable for initial differences on some other variable related to performance on the dependent. Suppose we were doing a study to compare two methods, X and Y, of teaching sixth standard students to solve mathematical problems. Covariate analysis statistically adjusts the scores of method Y to remove the initial advantage so that the results at the end of the study can be fairly compared as if the two groups started equally.

- (a) State the meaning of causal-comparative research.
- (b) Explain the steps and procedure of conducting causal-comparative research.
- (c) Explain the strengths and weaknesses of causal-comparative research.
- (d) Give examples of causal-comparative research in education.

4A.5 DOCUMENTARY ANALYSIS

Documentary Analysis is closely related to historical research since in such surveys we study the existing documents. But it is different from historical research in which our emphasis is on the study of the past; and in the descriptive research we emphasize on the study of the present. Descriptive research in the field of education may focus on describing the existing school practices, attendance rate of the students, health records, and soon.

The method of documentary analysis enables the researcher to include large amounts of textual information and systematically identify its properties. Documentary analysis today is a widely used research tool aimed at determining the presence of certain words or concepts within texts or sets of texts. Researchers quantify and analyze the presence, meanings and relationships of such words and concepts, then make inferences about the messages within the texts, the writer(s), the audience and even the culture and time of which these are a part. Documentary analysis could be defined as a research technique for the objective, systematic, and quantitative description of manifest content of communications. It is a technique for making inferences by objectively and systematically identifying specified characteristics of messages. The technique of documentary analysis is not restricted to the domain of textual analysis, but may be applied to other areas such as coding student drawings or coding of actions observed in videotaped studies, analyzing past documents such as memos, minutes of the meetings, legal and policy statements and so on. In order to allow for replication, however, the technique can only be applied to data that are durable in nature. Texts in documentary analysis can be defined broadly as books, book chapters, essays, interviews, discussions, newspaper headlines and articles, historical documents, speeches, conversations, advertising, theater, informal conversation, or really any occurrence of communicative language. Texts in a single study may also represent a variety of different types of occurrences.

Documentary analysis enables researchers to sift through large amount of data with comparative ease in a systematic fashion. It can be a useful technique for allowing one to discover and describe the focus of individual, group, institutional or social attention. It also allows inferences to be made which can then be corroborated using other methods of data collection. Much documentary analysis research is motivated by the search

for techniques to infer from symbolic data what would be too costly, no longer possible, or too obtrusive by the use of other techniques. These definitions illustrate that documentary analysis emphasizes an integrated view of speech/texts and their specific contexts. Document analysis is the systematic exploration of written documents or other artifacts such as films, videos and photographs. In pedagogic research, it is usually the contents of the artefacts, rather than say, the style or design, that are of interest.

Why analyses documents?

Documents are an essential element of day-to-day work in education. They include:

Student essays Exam papers Minutes of meetings Module outlines Policy documents

In some pedagogic research, analysis of relevant documents will inform the investigation. If used to triangulate, or give another perspective on a research question, results of document analysis may complement or refute other data. For example, policy documents in an institution may be analyzed and interviews with staff or students and observation of classes may suggest whether or not new policies are being implemented. A set of data from documents, interviews and observations could contribute to a study of a particular aspect of pedagogy.

How can documents be analyzed?

The content of documents can be explored in systematic ways which look at patterns and themes related to the research question(s). For example, in making a case study of deep and surface learning in a particular course, the question might be 'How has deep learning been encouraged in this course in the last three years?'

Minutes of course meetings could be examined to see whether or how much this issue has been discussed; Student handouts could be analysed to see whether they are expressed in ways which might encourage deep learning. Together with other data-gathering activities such as student questionnaires or observation of classes, an research study might then be based on an extended research question so that strategies are implemented to develop deep learning.

In the example of deep learning, perhaps the most obvious way to analyse the set of minutes would be to use a highlighting pen every time the term 'deep learning' was used. You might also choose to highlight 'surface learning' a term with an implied relationship to deep learning. You might also decide, either before starting the analysis, or after reading the documents, that there are other terms or inferences which imply an emphasis on deep learning. You might therefore go through the documents again, selecting additional references.

The levels of analysis will vary but a practitioner-researcher will need to be clear and explicit about the rationale for, and the approach to, selection of content.

Advantages and disadvantages of document analysis

Robson (2002) points out the advantages and disadvantages of content analysis. An advantage is that documents are unobtrusive and can be used without imposing on participants; they can be checked and re-checked for reliability.

A major problem is that documents may not have been written for the same purposes as the research and therefore conclusions will not usually be possible from document analysis alone.

Check Your Progress - III

1. State the meaning of documentary research.
2. Explain the applications of documentary research.

4A.6 ETHNOGRAPHY:

Meaning

Ethnographic studies are usually holistic, founded on the idea that human beings are best understood in the fullest possible context, including the place where they live, the improvements they have made to that place, how they make a living and gather food, housing, energy and water for themselves, what their marriage customs are, what language(s) they speak and so on. Ethnography is a form of research focusing on the sociology of meaning through close field observation of socio-cultural phenomena. Typically, the ethnographer focuses on a community (not necessarily geographic, considering also work, leisure, classroom or school groups and other communities). Ethnography may be approached from the point of view of art and cultural preservation and as a descriptive rather than analytic endeavour. It essentially is a branch of social and cultural anthropology. The emphasis in ethnography is on studying an entire culture. The method starts with selection of a culture, review of the literature pertaining to the culture, and identification of variables of interest - typically variables perceived as significant by members of the culture. Ethnography is an enormously wide area with an immense diversity of practitioners and methods. However, the most common ethnographic approach is participant observation and unstructured interviewing as a part of field research. The ethnographer becomes immersed in the culture as an active participant and records extensive field notes. In an ethnographic study, there is no preset limit of what will be observed and interviewed and no real end point in as is the case with grounded theory.

Hammersley and Atkinson define ethnography as, "We see the term as referring primarily to a particular method or sets of methods. In its most

characteristic form it involves the ethnographer participating, overtly or covertly, in people's lives for an extended period of time, watching what happens, listening to what is said, asking questions—in fact, collecting whatever data are available to throw light on the issues that are the focus of the research. Johnson defines ethnography as "a descriptive account of social life and culture in a particular social system based on detailed observations of what people actually do."

Assumptions in an Ethnographic Research

According to Garson, these are as follows:

- a. Ethnography assumes that the principal research interest is primarily affected by community cultural understandings. The methodology virtually assures that common cultural understandings will be identified for the research interest at hand. Interpretation is apt to place great emphasis on the causal importance of such cultural understandings. There is a possibility that an ethnographic focus will overestimate the role of cultural perceptions and underestimate the causal role of objective forces.
- b. Ethnography assumes an ability to identify the relevant community of interest. In some settings, this can be difficult. Community, formal organization, informal group and individual-level perceptions may all play a causal role in the subject under study and the importance of these may vary by time, place and issue. There is a possibility that an ethnographic focus may overestimate the role of community culture and underestimate the causal role of individual psychological or of sub-community (or for that matter, extra- community) forces.
- c. Ethnography assumes that the researcher is capable of understanding the cultural mores of the population under study, has mastered the language or technical jargon of the culture and has based findings on comprehensive knowledge of the culture. There is a danger that the researcher may introduce bias toward perspectives of his or her own culture.
- d. While not inherent to the method, cross-cultural ethnographic research runs the risk of falsely assuming that given measures have the same meaning across cultures.

Characteristics of Ethnographic Research:

According to Hammersley and Sanders, ethnography is characterized by the following features:

- (a) People's behaviour is studied in everyday contexts.
- (b) It is conducted in a natural setting.
- (c) Its goal is more likely to be exploratory rather than evaluative.
- (d) It is aimed at discovering the local person's or—native's point of view, wherein, the native may be a consumer or an end-user.

- (e) Data are gathered from a wide range of sources, but observation and/or relatively informal conversations are usually the principle ones.
- (f) The approach to data collection is unstructured in that it does not involve following through a predetermined detailed plan set up at the beginning of the study nor does it determine the categories that will be used for analysing and interpreting the soft data obtained. This does not mean that the research is unsystematic. It simply means that initially the data are collected as raw form and a wide amount as feasible.
- (g) The focus is usually a single setting or group of a relatively small size. In life history research, the focus may even be a single individual.
- (h) The analysis of the data involves interpretation of the meanings and functions of human actions and mainly takes the form of verbal descriptions and explanations, with quantification and statistical analysis playing a subordinate role at most.
- (i) It is cyclic in nature concerning data collection and analysis. It is open to change and refinement throughout the process as new learning shapes future observations. As one type of data provides new information, this information may stimulate the researcher to look at another type of data or to elicit confirmation of an interpretation from another person who is part of the culture being studied.

Guidelines for Conducting Ethnography

Following are some broad guidelines for conducting fieldwork:

1. Be descriptive in taking field notes. Avoid evaluations.
2. Collect a diversity of information from different perspectives.
3. Cross-validate and triangulate by collecting different kinds of data obtained using observations, interviews, programme documentation, recordings and photographs.
4. Capture participants' views of their own experiences in their own words. Use quotations to represent programme participants in their own terms.
5. Select key informants carefully. Draw on the wisdom of their informed perspectives, but keep in mind that their perspectives are limited.
6. Be conscious of and perceptive to the different stages of fieldwork.
 - (a) Build trust and rapport at the entry stage. Remember that the researcher-observer is also being observed and evaluated.
 - (b) Stay attentive and disciplined during the more routine middle-phase of fieldwork.
 - (c) Focus on pulling together a useful synthesis as

fieldwork draws to a close. (d) Be well-organized and meticulous in taking detailed field notes at all stages of fieldwork. (e) Maintain an analytical perspective grounded in the purpose of the fieldwork: to conduct research while at the same time remaining involved in experiencing the observed setting as fully as possible. (f) Distinguish clearly between description, interpretation and judgment. (g) Provide formative feedback carefully as part of the verification process of fieldwork. Observe its effect. (h) Include in your field notes and observations reports of your own experiences, thoughts and feelings. These are also field data. Fieldwork is a highly personal experience. The meshing of fieldwork procedures with individual capabilities and situational variation is what makes fieldwork a highly personal experience. The validity and meaningfulness of the results obtained depend directly on the observer's skill, discipline, and perspective. This is both the strength and weakness of observational methods.

Techniques Used in Conducting Ethnography

These include the following:

- A. Listening to conversations and interviewing. The researcher needs to make notes or audio-record these.
- B. Observing behaviour and its traces, making notes and mapping patterns of behaviour, sketching of relationship between people, taking photographs, video-recordings of daily life and activities and using digital technology and web cameras.

Stages in Conducting Ethnography

According to Spradley, following are the stages in conducting an ethnographic study:

- 1. Selecting an ethnographic project.
- 2. Asking ethnographic questions and collecting ethnographic data.
- 3. Making an ethnographic record.
- 4. Analyzing ethnographic data and conducting more research as required.
- 5. Outlining and writing an ethnography.

Steps of Conducting Ethnography

According to Spradley, ethnography is a non-linear research process but is rather, a cyclical process. As the researcher develops questions and uncovers answers, more questions emerge and the researcher must move through the steps again.

According to Spradley, following are the steps of conducting an ethnographic study (However, all research topics may not follow all the steps listed here):

1. Locating a social situation. The scope of the topic may vary from the micro ethnography of a single social situation to macro- ethnography of a complex society. According to Hymes, there are three levels of ethnography including (i) comprehensive ethnography which documents an entire culture,(ii) the topic oriented ethnography which looks at aspects of a culture and (iii) hypothesis-oriented ethnography which begins with an idea about why something happens in a culture. Suppose you want to conduct research on classroom environment. This step requires that you select a category of classroom environment and identify social and academic situations in which it issued.
2. Collecting data. There are four types of data collection used in ethnographic research, namely, (a) watching or being part of a social context using participant and non-participant observation and noted in the form of on observer notes, logs, diaries, and so on, (b) asking open and closed questions that cover identified topics using semi-structured interviews, (c) asking open questions that enable a free development of conversation using unstructured interviews and (d) using collected material such as published and unpublished documents, photographs, papers, videos and assorted artifacts, letters, books or reports. The problem with such data is that the more you have, greater is the effort required to analyse. Moreover, as the study progresses, the amount of data increases making it more difficult and sharp to analyse the data. Yet more data leads to better codes, categories, theories and conclusions. What is 'enough' data is subject to debate and may well be constrained by the time and resource the researcher has available. Deciding when and where to collect data can be a crucial decision. A profound analysis at one point may miss others, whilst a broad encounter may miss critical finer points. Several deep dives can be a useful method. Social data can be difficult to access due to ethics, confidentiality and determination necessary in such research. There is often less division of activity phases in qualitative research and the researcher may be coding as he proceeds with the study. The researcher usually uses theoretical and selective sampling for data collection.
3. Doing participant observation. Formulate open questions about the social situations under study. Malinowski opines that ethnographic research should begin with foreshadowed problems. These problems are questions that researchers bring to a study and to which they keep an open eye but to which they are not enslaved. Collect examples of the classroom environment. Select research tools/techniques. Spradley provides a matrix of questions about cultural space, objects, acts activities, events, time, actors, goals and feelings that researchers can use when just starting the study.
4. Making an ethnographic record. Write descriptions of classroom environment and the situations in which it issued.

5. Making descriptive observations. Select method for doing analysis.
6. Making domain analysis. Discover themes within the data and apply existing theories, if any, as applicable. Domain analysis requires the researcher to first choose one semantic relationship such as—causes or— classes. Second, you select a portion of your data and begin reading it and while doing so, fill out a domain analysis worksheet where you list all the terms that fit the semantic relationship you chose. Now formulate structural questions for each domain. Structural questions occur less frequently as compared to descriptive questions in normal conversation. Hence they require more framing. Types of structural questions include the following:
 - (i) **Verification and elicitation questions** such as (a) verification of hypotheses (Is the teacher-student relationship a conducive?), (b) domain verification (Are there different types of teacher-student relationships? What are the different types? (c) verification of included terms (is teachers 'strike an illegal activity?) and (d) verification of semantic relationship (Is teaching beautiful?).
 - (ii) **Frame substitution.** This requires starting with real sentence like "you get a lot of brickbats in administration". Then ask, can you think of any other terms that go in that sentence instead of brickbats? You get a lot of in administration. (This can be done systematically by giving them list of terms to choose from).
 - (iii) **Card sorts.** Write phrases or words on cards. Then lay them out and ask the questions mentioned above. The researcher can ask which words are similar. Testing hypotheses about relations between domains and between domains and items. Like: "Are there different kinds of classroom climates?" If yes, it is a domain. Then ask "what kinds of classroom climates are there? || The final step in domain analysis is to make a list of all the hypothetical domains you have identified, the relationships in these domain and the structural questions that follow your analysis.
7. Making focused observations.
8. Making a taxonomic analysis. Taxonomy is a scientific process of classifying things and arranging them in groups or a set of categories (domains) organised on a single semantic relationships. The researcher needs to test his taxonomies against data given by informants. Make comparisons of two or three symbols such as word, event, constructs.
9. Making selected observations.
10. Making a componential analysis which is a systematic search for the attributes or features of cultural symbols that distinguish them from others and give them meaning. The basic idea in componential analysis is that all items in a domain can be decomposed into combinations of semantic features which combine to give the item meaning.

11. Discovering cultural themes. A theme is a postulate or position, explicit or implicit, which is directly or indirectly approved and promoted in a society. Strategies of discovering cultural themes include (i) in-depth study of culture, (ii) making a cultural inventory, (iii) identifying and analysing components of all domains, (iv) searching for common elements across all domains such as gender, age, SES groups etc., (v) identifying domains that clearly show a strong pattern of behaviour, (vi) making schema of cultural scene and (vii) identifying generic (etic) codes usually functional such as social conflict, inequality, cultural contradictions in the institutional social system, strategies of social control, managing interpersonal relations, acquiring status in the institution and outside, solving educational and administrative problems and soon.
12. Taking a cultural inventory.
13. Writing an ethnography

Guidelines for Interviewing

According to Patton, following are some useful guidelines that can be used for effective interviewing:

1. Throughout all phases of interviewing, from planning through data collection to analysis, keep centered on the purpose of the research endeavor. Let that purpose guide the interviewing process.
2. The fundamental principle of qualitative interviewing is to provide a framework within which respondents can express their own understandings in their own terms.
3. Understand the strengths and weaknesses of different types of interviews: the informal conversational interview; the interview guide approach; and the standardized open-ended interview.
4. Select the type of interview (or combination of types) that is most appropriate to the purposes of the research effort.
5. Understand the different kinds of information one can collect through interviews: behavioural data; opinions; feelings; knowledge; sensory data; and background information.
6. Think about and plan how these different kinds of questions can be most appropriately sequenced for each interview topic, including past, present, and future questions.
7. Ask truly open-ended questions.
8. Ask clear questions, using understandable and appropriate language.
9. Ask one question at a time.
10. Use probes and follow-up questions to solicit depth and detail.

11. Communicate clearly what information is desired, why that information is important, and let the interviewee know how the interview is progressing.
12. Listen attentively and respond appropriately to let the person know he or she is being heard.
13. Avoid leading questions.
14. Understand the difference between a depth interview and an interrogation. Qualitative evaluators conduct depth interviews; police investigators and tax auditors conduct interrogations.
15. Establish personal rapport and a sense of mutual interest.
16. Maintain neutrality toward the specific content of responses. You are there to collect information not to make judgments about that person.
17. Observe while interviewing. Be aware of and sensitive to how the person is affected by and responds to different questions.
18. Maintain control of the interview.
19. Tape record whenever possible to capture full and exact quotations for analysis and reporting.
20. Take notes to capture and highlight major points as the interview progresses.
21. As soon as possible after the interview check the recording for malfunctions; review notes for clarity; elaborate where necessary; and record observations.
22. Take whatever steps are appropriate and necessary to gather valid and reliable information.
23. Treat the person being interviewed with respect. Keep in mind that it is a privilege and responsibility to peer into another person's experience.
24. Practice interviewing. Develop your skills.
25. Enjoy interviewing. Take the time along the way to stop and "hear" the roses.

Writing Ethnographic Research Report

The components of an ethnographic research report should include the following:

1. Purpose / Goals /Questions.
2. Research Philosophy.

3. Conceptual/Theoretical Framework
4. Research Design /Model.
5. Setting/Circumstances.
6. Sampling Procedures.
7. Background and Experience of Researcher.
8. Role/s of Researcher.
9. Data Collection Method.
10. Data Analysis/Interpretation.
11. Applications/Recommendations.
12. Presentation Format and Sequence.

Advantages of Ethnography

These are as follows:

1. It provides the researcher with a much more comprehensive perspective than other forms of research
2. It is also appropriate to behaviors that are best understood by observing them within their natural environment(dynamics)

Disadvantages of Ethnography

These are as follows:

1. It is highly dependent on the researcher's observations and interpretations
2. There is no way to check the validity of the researcher's conclusion, since numerical data is rarely provided
3. Observer bias is almost impossible to eliminate
4. Generalizations are almost non-existent since only a single situation is observed, leaving ambiguity in the study.
5. It is very time-consuming.

Check Your Progress - IV

- (a) State the characteristics of ethnographic research.
- (b) Explain the steps of conducting ethnographic research.

4A.7 CASE STUDY:

Case study research is descriptive research that involves describing and interpreting events, conditions, circumstances or situations that are occurring in the present. Case study seeks to engage with and report the complexities of social activity in order to represent the meanings that individual social actors bring to their social settings. It excels at bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Darwin's theory of evolution was based, in essence, on case study research, not experimentation, for instance. In education, this is one of the most widely used qualitative approaches of research.

According to Odum, —The case study method is a technique by which individual factor whether it be an institution or just an episode in the life of an individual or a group is analyzed in its relationship to any other in the group. Its distinguishing characteristic is that each respondent is (individual, family, classroom, institution, cultural group) is taken as a unit and the unitary nature of individual case is the focus of analysis. It seeks to engage with and report the complexity of social and/or educational activity in order to represent the meanings that individual actors in the situation bring to that setting. It assumes that social and/or educational reality is created through social interactions, situated in specific contexts and histories and seeks to identify and describe followed by analysing and theorizing. It assumes that things may not be as they seem and involve in-depth analysis so as to understand a case 'rather than generalizing to a larger population. It derives much of its philosophical underpinnings and methodology from ethnography, symbolic interactionism, ethnomethodology and phenomenology. It follows the social constructivism 'perspective of social sciences.

Most case studies are usually qualitative in nature. Case study research excels at enabling us to understand a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies involve a detailed contextual analysis of a limited number of events or conditions and their relationships. Social scientists have made a wide use of this qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods. Yin defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

However, some case studies can also be quantitative in nature especially if they deal with cost-effectiveness, cost-benefit analysis or institutional effectiveness. Many case studies have been done by combining the qualitative as well as the quantitative approaches in which initially the qualitative approach has been used and data have been collected using

interviews and observations followed by the quantitative approach. The approach of case studies ranges from general field studies to interview of a single individual or group. A case study can be precisely focused on a topic or can include a broad view of life and society. For example, a case study can focus on the life of a single gifted student, his actions, behaviour, abilities and so on in his school or it can focus on the social life of an individual including his entire background, experiences, motivations and aspirations that influence his behaviour society. Examples of case studies include a case of curriculum development, of innovative training, of disruptive behaviour, of an ineffective institution and so on.

Case studies can be conducted to develop a research-based 'theory with which to analyse situations: a theory of, for and about practice. It is essential to note that since most case studies focus on a single unit or small number of units, the findings cannot be generalised to larger populations. However, its utility cannot be underestimated. A case study is conducted with a fundamental assumption that though human behaviour is situation-specific and individualized, there is a predictable uniformity in basic human nature.

A case study can be conducted to explore, to describe or to explain a phenomenon. It could be a synchronic study in which data are collected at one point of time or it could be longitudinal in nature. It could be conducted at a single site or it could be multi-site. In other words, it is inherently a very flexible methodology.

A case typically refers to a person, either a learner, a teacher, an administrator or an entity, such as a school, a university, a classroom or a programme. In some policy-related research, the case could be a country. Case studies may be included in larger quantitative or qualitative studies to provide a concrete illustration of findings, or they may be conducted independently, either longitudinally or in a more restricted temporal period. Unlike ethnographic research, case studies do not necessarily focus on cultural aspects of a group or its members. Case study research may focus on a single case or multiple cases.

Characteristics of a Case Study

Following are the characteristics of a case study:

1. It is concerned with an **exhaustive** study of particular instances. A case is a particular instance of a phenomenon. In education, examples of phenomena include educational programmes, curricula, roles, events, interactions, policies, process, concept and so on. Its distinguishing feature is that each respondent (individual, class, institution or cultural group) is treated as a unit.
2. It emphasises the study of interrelationship between different attributes of a unit.
3. According to Cooley, case study deepens our perception and gives us a clear insight into life... It gets at behaviour directly and not by an indirect or abstract approach.

4. Each case study needs to have a clear **focus** which may include those aspects of the case on which the data collection and analysis will concentrate. The focus of a study could be a specific topic, theme, proposition or a working hypothesis.
5. It focuses on the natural history of the unit under study and its interaction with the social world around it.
6. The progressive records of personal experience in a case study reveals the internal strivings, tensions and motivations that lead to specific behaviours or actions of individuals or the unit of analysis.
7. In order to ensure that the case study is intensive and in-depth, data are collected over a long period of time from a variety of sources including human and material and by using a variety of techniques such as interviews and observations and tools such as questionnaires, documents, artifacts, diaries and soon.
8. According to Smith, as cited by Merriam, (1998), these studies are different from other forms of qualitative of research in that they focus on a **single unit** or a **bounded system**. A system is said to be a bounded system if it includes a finite or limited number of cases to interviewed or observed within a definite amount of time.
9. It may be defined as an in-depth study of one or more instances of a phenomenon- an individual, a group, an institution, a classroom or an event- with the objective of discovering meaning, investigating processes, gaining an insight and an understanding of an individual, group or phenomena within the context in such a way that it reflects there all if context of the participants involved in the phenomena. These individuals, groups, institutions, classrooms or events may represent the **unit of analysis** in a case study. For example, in a case study, the unit of analysis may be a classroom and the researcher may decide to investigate the events in three such classrooms.
10. According to Yin, case studies typically involve investigation of a phenomenon for which the boundaries between the phenomenon and its context are not clearly evident. These boundaries should be clearly clarified as part of the case study. He further emphasises the importance of conducting a case study in its real life context. In education, the classroom or the school is the real life context of a case study as the participants of such a case study are naturally found in these settings.
11. There are two major perspectives in a case study, namely, the ethic perspective and the epic perspective. The ethic perspective is that of the researcher (i.e. the outsider's perspective) whereas the epic perspective is that of the research participants including teachers, principals and students (i.e. the insider's perspective). This enables the researcher to study the local, immediate meanings of social actions of the participants and to study how they view the social situation of the

setting and the phenomenon under study. A comprehensive case study includes both the perspectives.

12. A case study can be a single-site study or a multi-site study.
13. Cases are selected on the basis of dimensions of a theory (pattern-matching) or on diversity on a dependent phenomenon (explanation-building).
14. No generalization is made to a population beyond cases similar to those studied.
15. Conclusions are phrased in terms of model elimination, not model validation. Numerous alternative theories may be consistent with data gathered from a case study.
16. Case study approaches have difficulty in terms of evaluation of low-probability causal paths in a model as any given case selected for study may fail to display such a path, even when it exists in the larger population of potential cases.
17. Acknowledging multiple realities in qualitative case studies, as is now commonly done, involves discerning the various perspectives of the researcher, the case/participant, and others, which may or may not converge.

Components of a Case Study Design

According to Yin, following are the five component elements of a case study design:

1. Study questions
2. Study propositions (if any are being used) or theoretical framework
3. Identification of the units of analysis
4. The logical linking of the data to the propositions (or theory)
5. The criteria for interpreting the findings.

The purpose of a case study is a detailed examination of a specific activity, event, institution, or person/s. The hypotheses or the research questions are stated broadly at the beginning at the study. A study's questions are directed towards how and why considerations and enunciating and defining these are the first task of the researcher. The study's propositions could be derived from these how and why questions. These propositions could help in developing a theoretical focus. However, all case studies may not have propositions. For instance, an exploratory case study may give only a purpose statement or criteria that could guide the research process. The unit of analysis defines what the case study is focusing on, whether an individual, a group, an institution, a city, a society, a nation and so on. Linkages between the data and the propositions (or theory) and the criteria for interpreting the findings are usually the least developed aspects of case studies (Yin, 1994).

Types of Case Study Designs

Yin (1994) and Winston (1997) have identified several types of case study designs. These are as follows:

(A) Exploratory Case Study Design: In this type of case study design, field work and data collection are carried out before determining the research questions. It examines a topic on which there is very little prior research. Such a study is a prelude to a large social scientific study. However, before conducting such an exploratory case study, its organizational framework is designed in advance so as to ensure its usefulness as a pilot study of a larger, more comprehensive research. The purpose of the exploratory study is to elaborate a concept, build up a model or advocate propositions.

(B) Explanatory Case Study Design: These are useful when providing explanation to phenomena under consideration. These explanations are patterns implying that one type of variation observed in a case study is systematically related to another variation. Such a pattern can be a relational pattern or a causal pattern depending on the conceptual framework of the study. In complex studies of organisations and communities, multivariate cases are included so as to examine a plurality of influences. Yin and Moore (1988) suggest the use of a pattern-matching technique in such a research wherein several pieces of information from the same case may be related to some theoretical proposition.

(C) Descriptive Case Study Design: A descriptive case study necessitates that the researcher present a descriptive theory which establishes the overall framework for the investigator to follow throughout the study. This type of case study requires formulation and identification of a practicable theoretical framework before articulating research questions. It is also essential to determine the unit of analysis before beginning the research study. In this type of case study, the researcher attempts to portray a phenomenon and conceptualize it, including statements that recreate a situation and context as much as possible.

(D) Evaluative Case Study Design: Often, in responsive evaluation, quasi-legal evaluation and expertise-based evaluation, a case study is conducted to make judgments. This may include a deep account of the phenomenon being evaluated and identification of most important and relevant constructs, themes and patterns. Evaluative case studies can be conducted on educational programmes funded by the Government such as —Sarva Shiksha Abhiyan or Orientation Programmes and Refresher Courses conducted by Academic Staff Colleges for college teachers or other such programmes organised by the State and Local Governments for secondary and primary schoolteachers.

Steps of Conducting a Case Study

Following are the steps of a case study:

1. Identifying a current topic which is of interest to the researcher.

2. Identifying research questions and developing hypotheses (if any).
3. Determining the unit of sampling and the number of units. Select the cases.
4. Identifying sources, tools and techniques of data collection. These could include interviews, observations, documentation, student records and school databases. Collect data in the field.
5. Evaluating and Analysing Data.
6. Report writing.

Each of these is described in detail in the following paragraphs.

Step 1 : Identifying a current topic which is of interest to the researcher

In order to identify a topic for case study research, the following questions need to be asked:

- (i) What kind of topics can be addressed using the case study method?
- (ii) How can a case study research be designed, shaped and scoped in order to answer the research question adequately?
- (iii) How can the participation of individuals/institutions be obtained for the case study research?
- (iv) How can case study data be obtained from case participants in an effective and efficient manner?
- (v) How can rigor be established in the case study research report so that it is publishable in academic journals?

According to Maxwell, there are eight different factors that could influence the goals of a case study as follows:

1. To grasp the meanings that events, situations, experiences and actions have for participants in the study which is part of the reality that the researcher wants to understand.
2. To understand the particular context within which the participants are operating and its influence on their actions, in addition to the context in which one's research participants are embedded. Qualitative researchers also take into account the contextual factors that influence the research itself.
3. To identify unanticipated phenomena and influences that emerge in the setting and to generate new grounded theories about such aspects.
4. To grasp the process by which events and actions take place that lead to particular outcomes.

5. To develop causal explanations based on process theory (which involves tracing the process by which specific aspects affect other aspects), rather than variance theory (which involves showing a relationship between two variables as in quantitative research).
6. To generate results and theories that are understandable and experientially credible, both to the participants in the study and to others.
7. To conduct summative evaluations designed to improve practice rather than merely to assess the value of a final programme or product.
8. To engage in collaborative and action research practitioners and research participants.

Step 2 : Identifying research questions and developing hypotheses (if any)

The second step in case study research is to establish a research focal point by forming questions about the situation or problem to be studied and determining a purpose for the study. The research objective in a case study is often a programme, an entity, a person or a group of people. Each objective is likely to be connected to political, social, historical and personal issues providing extensive potential for questions and adding intricacy to the case study. The researcher attains the objective of the case study through an in-depth investigation using a variety of data gathering methods to generate substantiation that leads to understanding of the case and answers the research questions. Case study research is usually aimed at answering one or more questions which begin with "how" or "why." The questions are concerned with a limited number of events or conditions and their inter-relationships. In order to formulate research questions, literature review needs to be undertaken so as to establish what research has been previously conducted. This helps in refining the research questions and making them more insightful. The literature review, definition of the purpose of the case study and early determination of the significance of the study for potential audience for the final report direct how the study will be designed, conducted and publicly reported.

Step 3: Determining the unit of sampling and the number of units. Select the cases.

Sampling Strategies in a Case Study: In a case study design, purposeful sampling is done which has been defined by Patton as selecting information-rich cases for study in-depth. In a case study research, purposeful sampling is preferred over probability sampling as they enhance the usefulness of the information acquired from small samples. Purposive samples are expected to be conversant and informative about the phenomenon under investigation.

A case study requires a plan for choosing sites and participants in order to start data collection. The plan is known as a

emergent design in which research decisions depend on preceding information. This necessitates purposive sampling, data collection and partial, simultaneous analysis of data as well as interactive rather than distinct sequential steps.

During the phase of designing a case study research, the researcher determines whether to use single or multiple real-life cases to examine in-depth and which instruments and data collection techniques to use. When multiple cases are used, each case is treated as a single case. Each case/s conclusions can then be used as contributing information to the entire study, but each case remains a single case for collecting data and analysis. Exemplary case studies carefully select cases and carefully examine the choices available from among many research tools available so as to enhance the validity of the study. Careful selection helps in determining boundaries around the case. The researcher must determine whether to study unique cases', or typical cases'. He also needs to decide whether to select cases from different geographical areas. It is necessary at this stage to keep in mind the goals of the study so as to identify and select relevant cases and evidence that will fulfil the goals of the study and answer the research questions raised. Selecting multiple or single cases is a key element, but a case study can include more than one unit of embedded analysis. For example, a case study may involve study of a single type of school (For example, Municipal School) and a school belonging to this type. This type of case study involves two levels of analysis and increases the complexity and amount of data to be gathered and analyzed. Multiple cases are often preferable to single cases, particularly when the cases may not be representative of the population from which they are drawn and when a range of behaviors/profiles, experiences, outcomes, or situations is desirable. However, including multiple cases limits the depth with which each case may be analyzed and also has implications for the structure and length of the final report.

Step 4: Identifying sources, tools and techniques of data collection

Sources of Data in a Case Study: A case study method involves using multiple sources and techniques in the data collection process. The researcher determines in advance what evidence to collect and which techniques of data analysis to use so as to answer the research questions. Data collected is normally principally qualitative and soft data, but it may also be quantitative also. Data are collected from primary documents such as school records and databases, students' records, transcripts and results, field notes, self-reports or think- aloud protocols and memoranda. Techniques used to collect data can include surveys, interviews, questionnaires, documentation review, observation and physical artefacts. These multiple tools and techniques of data collection add texture, depth, and multiple insights to an analysis and can enhance the validity or credibility of the results.

Case studies may make use of field notes and databases to categorize and reference data so that it is readily available for subsequent re-interpretation. Field notes record feelings and intuitive hunches, pose

questions, and document the work in progress. They record testimonies, stories and illustrations which can be used in reporting the study. They may inform of impending preconceptions because of the detailed exposure of the client to special attention or give an early signal that a pattern is emerging. They assist in determining whether or not the investigation needs to be reformulated or redefined based on what is being observed. Field notes should be kept separate from the data being collected and stored for analysis.

According to Cohen and Manion, the researcher must use the chosen data collection tools and techniques systematically and properly in collecting the evidence. Observations and data collection settings may range from natural to artificial, with relatively unstructured to highly structured elicitation tasks and category systems depending on the purpose of the study and the disciplinary traditions associated with it.

Case studies necessitate that effective training programmes be developed for investigators, clear protocols and procedures be established in advance before starting the field work and conduct a pilot study in before moving into the field so as to eliminate apparent obstacles and problems. The researcher training programme need to cover the vital concepts of the study, terminology, processes and methods and need to teach researcher/s how to apply the techniques being used in the study accurately. The programme should also be aimed at training researcher/s to understand how the collection of data using multiple techniques strengthens the study by providing opportunities for triangulation during the analysis phase of the study. The programme should also include protocols for case study research including time deadlines, formats for narrative reporting and field notes, guidelines for collection of documents, and guidelines for field procedures to be used. Investigators need to be good listeners who can hear exactly the words being used by those interviewed. Qualities of effective investigators also include being able to ask good questions and interpret answers. Effective investigators not only review documents looking for facts but also read between the lines and pursue collaborative evidence elsewhere when that seems appropriate. Investigators need to be flexible in real-life situations and not feel threatened by unexpected change, missed appointments or lack of space. Investigators need to understand the goals of the study and comprehend the issues and must be open to contrary findings. Investigators must also be aware that they are going into the world of real human beings who may be threatened or unsure of what the case study will bring.

After investigators are trained, the final advance preparation step is to select a site for pilot study and conduct a pilot test using all the data collection tools and techniques so that difficult and tricky areas can be uncovered and corrected. Researchers need to anticipate key problems and events, identify key people, prepare letters of introduction, establish rules for confidentiality, and actively seek opportunities to revisit and revise the research design in order to address and add to the original set of research questions.

Throughout the design phase, researchers must ensure that the construct validity, internal validity, external validity, and reliability of the tools and the research method are adequate. Construct validity requires the researcher to use the suitable measures for the concepts being studied. Internal validity (especially important in explanatory or causal studies) demonstrates that certain conditions/events (causes) lead to other conditions/events (effect/s) and necessitates the use of multiple sets of evidence from multiple sources to reveal convergent lines of inquiry. The researcher makes efforts to ascertain a series of substantiation forward and backward. External validity reflects whether findings are generalisable beyond the immediate case/s. The more variations in places, people and procedures a case study can withstand and still yield the same findings, the more will be its external validity. Techniques such as cross-case examination and within-case examination along with literature review help in ensuring external validity. Reliability refers to the stability, accuracy and precision of measurement. Exemplary case study design ensures that the procedures used are well documented and can be repeated with the same results over and over again. Establishing a trusting relationship with research participants, using multiple data collection procedures, obtaining sufficient pertinent background information about case participants and sites and having access to or contact with the case over a period of time are, in general, all decided advantageous.

Step 5 : Evaluating and analyzing data

The case study research generates a huge quantity of data from multiple sources. Hence systematic organisation of the data is essential in prevent the researcher from losing sight of the original research purpose and questions. Advance preparation assists in handling huge quantity of largely soft data in a documented and systematic manner. Researchers prepare databases for categorizing, sorting, storing and retrieving data for analysis. The researcher examines raw data so as to find linkages between the research object and the outcomes with reference to the original research questions. Throughout the evaluation and analysis process, the researcher remains open to new opportunities and insights. The case study method, with its use of multiple data collection methods and analysis techniques, provides researchers with opportunities to triangulate data in order to strengthen the research findings and conclusions. According to Creswell, analysis of data in case study research usually involves an iterative, spiraling or cyclical process that proceeds from more general to more specific observations. According to Miles and Huberman, data analysis may commence during interviews or observations and continue during transcription, when recurring themes, patterns and categories become apparent. Once written records are available, analysis involves the coding of data and the identification of prominent points or structures. Having additional coders is highly desirable, especially in structural analyses of discourse, texts, syntactic structures or interaction patterns involving high-inference categories leading ultimately to the quantification of types of items within categories. Data reduction may include quantification or other means of data aggregation and reduction, including the use of data matrices, tables, and figures.

The strategies used in analysis require researchers to move beyond initial impressions to improve the likelihood of precise and consistent findings. Data need to be consciously sorted in many different ways to expose or create new insights and will deliberately look for contradictory data to disconfirm the analysis. Researchers categorize, tabulate and recombine data to answer the initial research questions and conduct cross-checking of facts and incongruities in accounts. Focused, short, repeated interviews may be essential to collect supplementary data to authenticate key observations or check a fact.

Precise techniques that could be used for data analysis include placing information into arrays, creating matrices of categories, creating flow charts or other displays and tabulating frequency of events. Researchers can use quantitative data to substantiate and support the qualitative data so as to comprehend the *raison d'être* or theory underlying relationships. Besides, multiple investigators could be used to gain the advantage provided when diverse perspectives and insights scrutinize the data and the patterns. When the multiple observations converge, reliability of the findings enhances. Inconsistent discernments, on the other hand, necessitate the researchers to inquire more intensely. Moreover, the cross-case search for patterns, keeps investigators from reaching untimely conclusions by requiring that investigators look at the data in diverse ways. Cross-case analysis divides the data by type across all cases investigated. One researcher then examines the data of that type carefully. When a pattern from one data type is substantiated by the evidence from another, the result is stronger. When substantiation conflicts, deeper probing of the variation is necessary to identify the cause/s or source/s of conflict. In all cases, the researcher treats the evidence reasonably to construct analytic conclusions answering the original "how" and "why" research questions.

Step 6 : Report writing

Case studies report the data in a way that transforms a multifarious issue into one that can be understood, permitting the reader to question and examine the study and reach an understanding independent of the researcher. The objective of the written report is to depict a multifaceted problem in a way that conveys an explicit experience to the reader. Case studies should present data in a way that leads the reader to apply the experience in his or her own real- life situation. Researchers need to pay exacting consideration to displaying adequate evidence to achieve the reader's confidence that all avenues have been explored, clearly communicating the confines of the case and giving special attention to conflicting propositions.

In general, a research report in a case study should include the following aspects:

- A statement of the study's purpose and the theoretical context.
- The problem or issue being addressed.

- Central research questions.
- A detailed description of the case(s) and explanation of decisions related to sampling and selection.
- Context of the study and case history, where relevant. The research report should provide sufficient contextual information about the case, including relevant biographical and social information (depending on the focus), such as teaching - learning history, students' and teachers' background, years of studying/working in the institution, data collection site(s) or other relevant descriptive information pertaining to the case and situation.
- Issues of access to the site/participants and the relationship between you and the research participant (case).
- The duration of the study.
- Evidence that you obtained informed consent, that the participants' identities and privacy are protected, and, ideally, that participants benefited in some way from taking part in the study.
- Methods of data collection and analysis, either manual or computer-based data management and analysis (see Weitzman & miles, 1995), or other equipment and procedures used.
- Findings, which may take the form of major emergent themes, developmental stages, or an in-depth discussion of each case in relation to the research questions; and illustrative quotations or excerpts and sufficient amounts of other data to establish the validity and credibility of the analysis and interpretations.
- A discussion of factors that might have influenced the interpretation of data in undesired, unanticipated, or conflicting ways.

A consideration of the connection between the case study and larger theoretical and practical issues in the field is essential to report. The report could include a separate chapter handling each case separately or treating the case as a chronological recounting. Some researchers report the case study as a story. During the report preparation process, the researcher critically scrutinizes the report trying to identify ways of making it comprehensive and complete. The researcher could use representative audience groups to review and comment on the draft report. Based on the comments, the researcher could rewrite and revise the report. Some case study researchers suggest that the report review audience should include the participants of the study.

Strengths of Case Study Method

1. It involves detailed, holistic investigation of all aspects of the unit under study.
2. Case studies data are strong in reality.

3. It can utilize a wide range of measurement tools and techniques.
4. Data can be collected over a period of time and is contextual.
5. It enables the researcher to assess and document not just the empirical data but also how the subject or institution under study interacts with the larger social system.
6. Case study reports are often written in non-technical language and are therefore easily understood by laypersons.
7. They help in interpreting similar other cases.

Weaknesses of Case Study Method

1. The small sample size prevents the researcher from generalizing to larger populations.
2. The case study method has been criticized for use of a small number of cases can offer no grounds for establishing reliability or generality of findings.
3. The intense exposure to study of the case biases the findings.
4. It has also been criticized as being useful only as an exploratory tool.
5. They are often not easy to cross-check.

Yet researchers continue to use the case study research method with success in carefully planned and crafted studies of real-life situations, issues, and problems.

Check Your Progress - V

- (a) State the meaning of case study research.
- (b) Explain the characteristics of case study research.
- (c) Explain the steps of case study research.

4A.8 ANALYTICAL METHOD:

It involves the identification and interpretation of data already existing in documents, pictures and artifacts. It is a form of research in which events, ideas, concepts or artifacts are examined through analysis of documents, records, recordings or other media. Here, contextual information is very essential to for an accurate interpretation of data. Historical research comprises of systematic collection and analysis of documents, records and artifacts with the objective of providing a description and interpretation of past events or persons. Its application lies in a range of research methods such as historical research which could use both quantitative and qualitative data, legal analysis which focuses on selected laws and court decisions with the objective of understanding how legal principles and

precedents apply to educational practices, concept analysis which is carried out to understand the meaning and usage of educational concepts (eg. school-based reforms, ability grouping, affective teacher education) and content analysis which is carried out to understand the meaning and identify properties of large amounts of textual information in a systematic manner.

Characteristics of Analytical Research

Following are the characteristics of analytical research:

1. It does not create‘ or generate‘ data through research tools and techniques.
2. The topic of analytical research deals with the past.
3. It reinterprets existing data.
4. It predominantly uses primary sources for collecting data.
5. Internal and external criticism is used as a technique while searching for facts and providing interpretative explanations.
6. It uses documents, relics and oral testimonies for collecting data.

Objectives Analytical Research

Following are the objectives of analytical research:

1. It offers understanding of the past/existing/available data.
2. It enables the researcher to shed light on existing policies by interpreting the past.
3. It generates a sense of universal justification and underlying principles and aims of education in a society.
4. It reinterprets the past for each age group.
5. It uses data and logic to analyse the past and demythologizes idealized conceptions of the past.

Check Your Progress - VI

- (a) State the meaning of analytical research.

4A.9 SURVEY RESEARCH

Survey research is the collection of data attained by asking individuals questions either in person, on paper, by phone or online. Conducting surveys is one form of primary research, which is the gathering data first-hand from its source. The information collected may also be accessed subsequently by other parties in secondary research.

Survey research is used to gather the opinions, beliefs and feelings of selected groups of individuals, often chosen for demographic sampling. These demographics include age, gender, ethnicity or income levels. The most famous public survey focused on demographics is the United States Census, which occurs every ten years.

Common types of surveys include interviews and questionnaires, which are comprised of multiple choice questionnaires, opinions and polls. Questionnaires are distributed through mail surveys, group administered questionnaires or in-person drop-offs. Interviews can be held in person or over the phone and are often a more personal form of research than questionnaires. There are several issues to consider when creating a survey, including content, wording, response format and question placement and sequence. All of these choices can affect the answers given by participating individuals.

Survey research is used academia, government and business. Governments use research surveys to learn about their populations to help better serve its citizens, while political candidates use survey research to gauge the preferences and opinions of voters. Businesses use surveys to gather information about customer attitudes and experiences to help market consumer products. In academia, surveys are applied in fields like demographics, statistics and social research.

Types of Surveys

Surveys can be divided into two broad categories: the **questionnaire** and the **interview**. Questionnaires are usually paper-and-pencil instruments that the respondent completes. Interviews are completed by the interviewer based on the respondent says. Sometimes, it's hard to tell the difference between a questionnaire and an interview. For instance, some people think that questionnaires always ask short closed-ended questions while interviews always ask broad open-ended ones. But you will see questionnaires with open-ended questions (although they do tend to be shorter than in interviews) and there will often be a series of closed-ended questions asked in an interview.

Survey research has changed dramatically in the last ten years. We have automated telephone surveys that use random dialing methods. There are computerized kiosks in public places that allows people to ask for input. A whole new variation of group interview has evolved as focus group methodology. Increasingly, survey research is tightly integrated with the delivery of service. Your hotel room has a survey on the desk. Your waiter presents a short customer satisfaction survey with your check. You get a call for an interview several days after your last call to a computer company for technical assistance. You're asked to complete a short survey when you visit a website. Here, I'll describe the major types of questionnaires and interviews, keeping in mind that technology is leading to rapid evolution of meth.

4A.10 REFERENCES

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QUANTITATIVE AND QUALITATIVE RESEARCH-II (HISTORICAL RESEARCH)

Unit Structure:

4B.0 Objectives

4B.1 Introduction

4B.2 Meaning

4B.3 The purpose of Historical Research

4B.4 Characteristics of Historical Research

4B.5 Scope of Historical Research in Education

4B.6 Approaches to the study of History

4B.7 Steps in Historical Research

4B.8 Problems and Weaknesses to be avoided in Historical Research.

4B.9 Criteria of Evaluating Historical Research.

4B.0 OBJECTIVES:

After reading this unit the student will be able to:

- Define the meaning of historical research, its purposes and characteristics, scope and approaches to the study of history.
- Explain the steps of historical research.
- State the Weaknesses to be avoided in Historical Research.

4B.1 INTRODUCTION:

History usually refers simply to an account of the past of human societies. It is the study of what “can be known to the historian)...through the surviving record.” Gottschal K referred to this as ‘history as record’, He further stated that “The process of critically examining and analyzing the records and survivals of the past is...called historical method. The imaginative reconstruction of the past from the data derived by that process is called historiography (the writing of history)”.

4B.2 MEANING:

Historical research has been defined as the systematic and objective location, evaluation and synthesis of evidence in order to establish facts and draw conclusions about past events. It involves a critical

inquiry of a previous age with the aim of reconstructing a faithful representation of the past. In historical research, the investigator studies documents and other sources that contain facts concerning the research theme with the objective of achieving better understanding of present policies, practices, problems and institutions. An attempt is made to examine past events or combinations of events and establish facts in order to arrive at conclusions concerning past events or predict future events. Historical research is a type of analytical research. Its common methodological characteristics include (i) identifying a research topic that addresses past events, (ii) review of primary and secondary data, (iii) systematic collection and objective evaluation of data related to past occurrences with the help of techniques of criticism for historical searches and evaluation of the information and (iv) synthesis and explanation of findings in order to test hypotheses concerning causes, effects or trends of these events that may help to explain present events and anticipate future events. Historical studies attempt to provide information and understanding of past historical, legal and policy events. The historical method consists of the techniques and guidelines by which historians use historical sources and other evidences to research and then to write history.

4B.2 THE PURPOSE OF HISTORICAL RESEARCH:

Conducting historical research in education can serve several purposes as follows:

1. It enables educationists to find out solutions to contemporary problems which have their roots in the past. i.e. it serves the purpose of bringing about reforms in education. The work of a historical researcher sometimes sensitizes educators to unjust or misguided practices in the past which may have unknowingly continued into the present and require reform. A historical researcher studies the past with a detached perspective and without any ego-involvement with the past practices. Hence it could be easier for educationists to identify misguided practices thus enabling them to bring about reforms.
2. It throws light on present trends and can help in predicting future trends. If we understand how an educationist or a group of educationists acted in the past, we can predict how they will act in future. Similarly, studying the past enables a researcher to understand the factors/causes affecting present trends. In order to make such future predictions reliable and trustworthy, the historical researcher needs to identify and clearly describe in which ways the past differs from the present context and how the present social, economic and political situations and policies could have an impact on the present and the future.
3. It enables a researcher to re-evaluate data in relation to selected hypotheses, theories and generalizations that are presently held about the past.

4. It emphasizes and analyzes the relative importance and the effect of the various interactions in the prevailing cultures.
5. It enables us to understand how and why educational theories and practices developed.

4B.3 CHARACTERISTICS OF HISTORICAL RESEARCH

These are as follows:

1. It is not a mere accumulation of facts and data or even a portrayal of past events.
2. It is a flowing, vibrant report of past events which involves an analysis and explanation of these occurrences with the objective of recapturing the nuances, personalities and ideas that influenced these events.
3. Conducting historical research involves the process of collecting and reading the research material collected and writing the manuscript from the data collected. The researcher often goes back-and-forth between collecting, reading, and writing. i.e. the process of data collection and analysis are done simultaneously are not two distinct phases of research.
4. It deals with discovery of data that already exists and does not involve creation of data using structured tools.
5. It is analytical in that it uses logical induction.
6. It has a variety of foci such as issues, events, movements and concepts.
7. It records and evaluates the accomplishments of individuals, agencies or institutions.

4B.4 SCOPE OF HISTORICAL RESEARCH IN EDUCATION

1. General educational history of specific periods such as (a) ancient India, (b) A during British rule, (c) Independent India etc.
2. History of specific levels of education (a) primary education, (b) secondary education, (c) tertiary education etc. in India.
3. History of specific types of education such as (a) adult education, (b) distance education, (c) disadvantaged education, (d) women's education in India.
4. Historical study of specific educational institutions such as (i) University of Mumbai, (ii) Aligarh Muslim University and soon.
5. History of the role of the teacher in ancient India.

6. History of specific components of education such as (a) curriculum, (b) text-books, (c) teaching-learning methods, (d) aims and objectives of education, (e) teacher-student relationships, (f) evaluation process and soon.
7. History of national education policies in India.
8. History of admission processes in professional / technical courses (medicine, engineering, management) in India.
9. History of teacher education.
10. Historical biographies of major contributors to education such as Mahatma Gandhi, Maharshi Karve, Maharshi Phule, Shri Aurobindo, Gurudev Tagore and soon.
11. History of educational administration.
12. History of public financing of education.
13. History of educational legislation in India.
14. History of educational planning.
15. History of contemporary problems in India.
16. Historical study of the relationship between politics and education in India.
17. Historical study of the impact of the British rule in India.
18. Comparative history of education in India and some other country /countries.
19. Historical study of the system of state-sponsored inspection in India.
20. Historical study of education in specific Indian states such as Maharashtra, Tamil Nadu, Madhya Pradesh, Rajasthan etc.

In other words, historical research in education may be concerned with an individual, a group, an idea a movement or an institution.

If a historical study focuses on an entire country / society / system, i.e. if it is broad in scope, it is said to be a macro-level historical research. On the other hand, if its focus is narrow and includes a selective set of people or events of interest, it is said to be a micro-level historical research.

4B.5 APPROACHES TO THE STUDY OF HISTORY:

According to Monaghan and Hartman, there are four major approaches to the study of the past:

a. **Qualitative Approach:** This is what most laypersons think of as history: the search for a story inferred from a range of written or printed evidence. The resultant history is organized chronologically and presented as a factual tale:

a tale of a person who created reading textbooks, such as a biography of William Holmes Mc Guffey (Sullivan, 1994) or the Lindley Murray family (Monaghan, 1998) in the Western context. The sources of qualitative history range from manuscripts such as account books, school records, marginalia, letters, diaries and memoirs to imprints such as textbooks, children's books, journals, and other books of the period under consideration.

b. **Quantitative Approach** : Here, rather than relying on history by quotation, as the former approach has been negatively called, researchers intentionally look for evidence that lends itself to being counted and that is therefore presumed to have superior validity and generalizability. Researchers have sought to estimate the popularity of a particular textbook by tabulating the numbers printed, based on copyright records. The assumption is that broader questions such as the relationship between education and political system in India or between textbooks and their influence on children can thus be addressed more authoritatively.

c. **Content Analysis**: Here the text itself is the focus of examination. This approach uses published works as its data (in the case of history of textbooks, these might be readers, or examples of the changing contents of school textbooks in successive editions) and subjects them to a careful analysis that usually includes both quantitative and qualitative aspects. Content analysis has been particularly useful in investigating constructs such as race, caste etc.

d. **Oral History**: Qualitative, quantitative, and content approaches use written or printed text as their database. In contrast, the fourth approach, oral history, turns to living memory. For instance, oral historians interested in women's education could ask their respondents about their early experiences and efforts in women's education.

These four approaches are not, of course, mutually exclusive. Indeed, historians avail themselves of as many of these as their question, topic, and time period permit. This integration is possible because the nature of historical research cuts across a variety of approaches, all of which commence with the recognition of a topic and the framing of a question. In other words, a historical study may be quantitative in nature, qualitative in nature or a combination of the approaches.

Its purpose can be mainly descriptive, aiming to understand some specific development in a particular period of time in a particular culture; or it could be explanatory, trying to test and accept / reject widely held assumptions.

A historical investigation is conducted with objectivity and the desire to minimize bias, distortion and prejudice. Thus, it is similar to descriptive method of research in this aspect. Besides, it aims at describing all aspects of the particular situation under study (or all that is accessible) in its search for the truth. Thus, it is holistic, comprehensive in nature and is

similar to the interpretive approach. Though it is not empirical in nature (does not collect data through direct observation or experimentation), it does make use of reports (all the available written and/or oral material), it definitely qualifies to be a scientific activity. This is because it requires scholarship to conduct a systematic and objective study and evaluation and synthesis of evidence so as to arrive at conclusions. In other words, historical research is scientific in nature.

Moreover, any competent researcher in other types of empirical studies reviews the related literature so as to find out prior researches and theoretical work done on a particular topic. This requires studying journals, books, encyclopedias, unpublished theses and so on. This is followed by interpretation of their significance. These steps are common to empirical research and historical research. i.e. to some extent, every researcher makes use of the historical method in his/her research.

However, it should be mentioned here that historical researcher in education “discovers” already existing data from a wide range of historical sources such as documents, relics, autobiographies, diaries or photographs. On the other hand, in other types of educational studies, the researcher “creates” data through observations, measurement through tests and experimentation. To this extent, historical research differs from descriptive and experimental researches.

Check Your Progress - I

Q.1 Define the following

- (a) Characteristics of historical research in education.
- (b) Purposes of historical research.

Q.2 (a) Give examples of research topics in historical research.

- (b) Explain the approaches to historical research.

4B.6 STEPS IN HISTORICAL RESEARCH:

The essential steps involved in conducting a historical research are as follows:

- A. Identify a topic/subject and define the problems/questions to be investigated.
- B. Search for sources of data.
- C. Evaluate the historical sources.
- D. Analyze, synthesize and summarize interpreting the data / information.
- E. Write the research report.

Since most historical studies are largely qualitative in nature, the search for sources of data, evaluating, analyzing, synthesizing and summarizing

information and interpreting the findings may not always be discreet, separate, sequential steps i.e. the sequence of steps in historical research is flexible.

Let us now look at each of these steps in details.

A. Identify a Topic and Define the Problem

According to Borg, “In historical research, it is especially important that the student carefully defines his problem and appraises its appropriateness before committing himself too fully. Many problems are not adaptable to historical research methods and cannot be adequately treated using this approach. Other problems have little or no chance of producing significant results either because of the lack of pertinent data or because the problem is a trivial one.”

Beach has classified the problems that prompt historical inquiry into five types:

1. Current social issues are the most popular source of historical problems in education. e.g. Rural education, adult and continuing education, positive discrimination in education etc.
2. Histories of specific individuals, histories of specific educational institutions and histories of educational movement. These studies are often conducted with “the simple desire to acquire knowledge about previously unexamined phenomena”.
3. A historical study of interpreting ideas or events that previously had seemed unrelated. For example, history of educational financing and history of aims of education in India may be unrelated. But a person reviewing these two researches separately may detect some relationship between the two histories and design a study to understand this relationship.
4. A historical study aimed at synthesizing old data or merge them with new historical facts discovered by the researcher.
5. A historical inquiry involving reinterpretation of past events that have been studied by other historical researchers. This is known as revisionist history.

On the other hand, in order to identify a significant research problem, Gottschalk recommends that four questions should be asked:

- (i) Where do the events take place?
- (ii) Who are the persons involved?
- (iii) When do the events occur?
- (iv) What kinds of human activity are involved?

The scope of the study can be determined on the basis of the extent of emphasis placed on the four questions identified by Gottschalk i.e. the geographical area included, the number of persons involved, the time span included and the number and kinds of human activities involved often, the exact scope and delimitation of a study is decided by a researcher only after the relevant material has been obtained. The selection of a topic in historical research depends on several personal factors of the researcher such as his/her motivation, interest, historical knowledge and curiosity, ability to interpret historical facts and so on. If the problem selected involves understanding an event, an institution, a person, a past period, more clearly, it should be taken up for a research.

The topic selected should be defined in terms of the types of written materials and other resources available to you.

This should be followed by formulating a specific and testable hypothesis or a series of research questions, if required. This will provide a clear focus and direction to data collection, analysis and interpretation. i.e. it provides a structure to the study.

According to Borg, without hypotheses, historical research often becomes little more than an aimless gathering of facts.

B. Search for Sources of Data

Historical research is not empirical in that it does not include direct observation of events or persons. Here, the researcher interprets past events on the basis of traces they have left. He uses the evidence of past acts and thoughts. Thus, through he/she does not use his/her own observation but on other people's Observations. The researcher's job here is to test the truthfulness of the reports of other people's observations. These observations are obtained from several sources of historical data. Let us now try to discuss various sources of historical data.

Sources of Historical Data

These sources are broadly classified into two types:

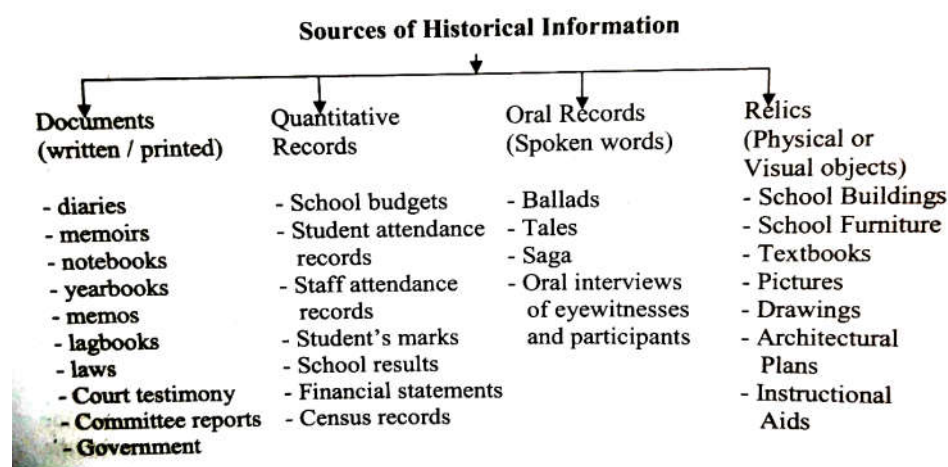
(a) **Primary Sources**: Gottschalk defines a primary data source as “the testimony of any eyewitness, or of a witness by any other of the senses, or of a mechanical device like the Dictaphone – that is, of one who...was present at the events of which he tells. A primary source must thus have been produced by a contemporary of the events it narrates.” In other words, primary sources are tangible materials that provide a description of an historical event and were produced shortly after the event happened. They have a direct physical relationship to the event being studied. Examples of primary sources include newspaper report, letters, public documents, court decisions, personal diaries, autobiographies, artifacts and eyewitness's verbal accounts. These primary sources of data can be divided into two broad categories as follows:

(i) The remains or relics of a given historical period. These could include photographs, coins, skeletons, fossils, tools, weapons, utensils, furniture, buildings and pieces of art and culture (object dart). Though these were not originally meant for transmitting information to future generations they could prove very useful sources in providing reliable and sound evidence about the past. Most of these relics provide non-verbal information.

(ii) Those objects that have a direct physical relationship with the events being reconstructed. This includes documents such as laws, files, letters, manuscripts, government resolutions, charters, memoranda, wills, news-papers, magazines, journals, films, government or other official publications, maps, charts ,log-books, catalogues, research reports, record of minutes of meetings, recording, inscriptions, transcriptions and so on.

(b) **Secondary Sources:** A secondary source is one in which the eyewitness or the participant i.e. the person describing the event was not actually present but who obtained his/her descriptions or narrations from another person or source. This another person may or may not be a primary source. Secondary sources, thus, do not have a direct physical relationship with the event being studies. They include data which are not original. Examples of secondary sources include textbooks, biographies, encyclopedias, reference books, replicas of art objects and paintings and so on. It is possible that secondary sources contain errors due to passing of information from one source to another. These errors could get multiplied when the information passes through many sources thereby resulting in an error of magnitude in the final data. Thus, wherever possible, the researcher should try to use primary sources of data. However, that does not reduce the value of secondary sources.

In conclusion, the various sources of historical information- both primary and secondary can be summarized as follows:



It must be mentioned here that the branch of historical research using all or some types of oral records is known as oral history.

It should also be mentioned here that some objects can be classified as documents or relics depending on the how they are used in a historical

study. For example, in a research study on how a historical figure (a politician, a freedom fighter or a social reformer) is presented in textbooks of different periods, the textbook will be classified as a document as the emphasis here is on analyzing its content-matter given in a verbal form. On the other hand, in a research study on printing methods in the past, the textbook can be used as a relic as the focus here is not on analyzing its contents but on its physical, outward characteristics or features.

Searching for Historical Data

The procedure of searching for historical data should be systematic and pre-planned. The researcher should know what information he needs so as to identify important sources of data and provide a direction to his search for relevant data. Using his knowledge, imagination and resourcefulness, he needs to explore the kinds of data required, persons involved, institutions involved. This will help him to identify the kinds of records the require and whom he should interview. Since a historical research is mainly qualitative in nature all the primary and secondary sources cannot be identified in advance. It is possible that as one collects some data, analyzes and interprets it, the need for further pertinent data may arise depending on the interpretive framework. This will enable him to identify other primary or secondary sources of data.

The search for sources of data begins with wide reading of preliminary sources including published bibliographies, biographies, atlas, specialized chronologies, dictionaries of quotations and terms. Good university and college libraries tend to have a great deal of such preliminary materials. This will enable a researcher to identify valuable secondary sources on the topic being studied such books on history relating to one's topic. For extensive materials on a subject, the researcher may need to go to a large research library or a library with extensive holdings on a specific subject. Such secondary materials could include other historian's conclusions and interpretations, historical information, references to other secondary and primary sources. The historical researcher needs to evaluate the secondary sources for their validity and authenticity. Now the researcher should turn his attention to the primary sources. These are usually available in the institution or the archives especially if the source concerns data pertaining to distant past or data pertaining to events in which the chief witnesses are either dead or inaccessible. In case of data concerning the recent past, the researcher can contact witnesses or participants themselves in order to interview them and/or study the documents possessed by them.

However, it is not possible for a historical researcher to examine all the material available. Selecting the best sources of data is important in a historical study. In a historical study the complete "population" of available data can never be obtained or known. Hence the sample of materials examined must always be a purposive one. What it represents and what it fails to represent should be considered. The researcher needs to identify and use a sample that should be representative enough for wider generalization.

c) **Evaluation of the Historical Sources**

The data of historical sources is subject to two types of evaluation. These two types are: (i) external evaluation or criticism and (ii) internal evaluation or criticism. Let us now look at these in detail.

(i) **External Criticism of Data:**

This is sometimes also known as lower criticism of data. External criticism regards the issue of authenticity of the data from the psychological attitude of the researcher in that it is primarily concerned with the question, is the source of data genuine? External criticism seeks to determine whether the document or the artifact that the researcher is studying is genuinely valid primary data. It is possible to get counterfeit documents or artifacts. External criticism of the sources of data is of paramount importance in establishing the credibility of the research. Although, theoretically, the main purpose of external criticism is the establishment of historical truth, in reality its actual operation is chiefly restricted to the negative role i.e. to identify and expose forgeries, frauds, hoaxes desertions and counterfeits. In order to identify such forgeries, researcher needs to look at problems pertaining to plagiarism, alterations of document, insertions, deletions or unintentional omissions. This will reveal whether the historical source of data is authentic or not. Establishing authenticity of documents may involve carbonating, handwriting analysis, identification of ink and paper, vocabulary usage, signatures, script, spelling, names of places and writing style and other considerations. In other words, it examines the document and its external features rather than the statements it contains. It tries to determine whether (a) the information it contains was available at the time the document was written? (b) this information is consistent with what is known about the author or the period from another source?

In other words, external criticism is aimed at answering questions about the nature of the historical source such as who wrote it? Where? When? Under which circumstances? Is it original? Is it genuine? and soon.

ii) **Internal Criticism of Data :**

Having established the authenticity of the source of historical data, the researcher now focuses his/her attention on the accuracy and worth of the data contained in the document. Internal criticism is concerned with the meaning of the written material. It is also known as higher criticism of data. It deals answering questions such as what does it mean? What was the author attempting to say? What thought was the author trying to convey? Is it possible that people would act in the way described in the document? Is it possible that events described occurred so quickly? What inferences or interpretations could be extracted from these words? Do the financial data / figures mentioned in the document seem reasonable for that period in the past? What does the decision of a court mean? What do the words of the decision convey regarding the intent and the will of the court? Is there any (unintended) misinformation given in the document? Is there any evidence of deception? and so on here, the researcher needs to

be very cautious so that he does not reject a statement only because the event described in the document appears to be improbable.

In addition to answering these questions, internal criticism should also include establishing the credibility of the author of the document. According to Travers, the following questions could be answered so as to establish the author's credibility: Was he a trained or untrained observer of the event? i.e. How competent was he? What was his relationship to the event? To what extent was he under pressure, from fear or vanity resulting in distortion or omission of facts? What was the intent of the writer of the document? To what extent was he an expert at recording the particular event? Were the habits of the author such that they might interfere with the accuracy of recording? Was he too antagonistic or too sympathetic to give a true picture? How long after the event did he record his testimony? Was he able to remember accurately? Is he in agreement with other independent witnesses?

These questions need to be answered for two reasons:

- i) Perceptions are individualized and selective. Even if eyewitnesses are competent and truthful, they could still record different descriptions of the events they witnessed or experienced.
- ii) Research studies in Psychology indicate that eye witnesses can be very unreliable, especially if they are emotionally aroused or under stress at the time of the event. (e.g. at the time of demolition of Babri Masjid or at the time of Gujarat riots in 2002.)

This brings us to the question of bias especially when life histories or communal situations are being studied. According to Plummer, there are three possible sources of bias as follows:

Source One: The Life History Informant

Is misinformation (unintended) given? Has there been evasion?

Is there evidence of direct lying and deception? Is a 'front' being presented?

What may the informant 'take for granted' and hence not reveal?

How far is the informant 'pleasing you'?

How much has been forgotten?

How much may be self-deception?

Source Two : The Social Scientist Research

Could any of the following be shaping the outcome?

- (a) Attitudes of researcher : age, gender, class, race etc.
- (b) Demeanor of researcher : dress, speech, body language etc.

- (c) Personality of researcher : anxiety, need for approval, hostility, warmth etc.
- (d) Attitudes researcher: religion, politics, tolerance, general assumptions
- (e) Scientific role of researcher: theory held etc. (researcher expectancy)

Source Three :The Interaction

The joint act needs to be examined. Is bias coming from

- (a) The physical setting—‘social ‘space
- (b) The prior interaction?
- (c) Non-verbal communication?
- (d) Vocal behavior?

Often, internal and external criticism are interdependent and complementary processes. The internal and external criticism of data require a high level of scholarship.

D. Analysis, Synthesis, Summarizing and Interpretation of Data:

We have seen how data can be located and evaluated. Let us now look at how to collect and control the data so that the greatest return from the innumerable hours spent in archives, document rooms and libraries can be reaped. The research should not only learn how to take notes but also learn how to organize the various notes, note cards, bibliography cards and memoranda so as to derive useful and meaningful facts for interpretation. Hence before beginning historical research, the researcher should have a specific and systematic plan for the acquisition, organization, storage and retrieval of the data. Following are some suggestions that may help you in systematizing your research efforts.

(i) Note cards and Bibliography Cards:

It would be convenient for you to prepare bibliography cards of size 3 × 5 inches for taking down bibliographical notes. A bibliography card is valuable not only for gathering and recording of information but also for locating it again at a future date, if necessary, without going back to the library again and again. Such a card contains the essential information concerning a bibliographical source. Keep plenty of such cards with you when you go to the library so that you can report very valuable references encountered unexpectedly. You can also noted own the document's relation to your research. A sample of a bibliographic reference card could be as follows:

Serial No. _____
Author(s) : _____
Title of the Document : _____
Name of the Journal : _____
Vol. _____ No. _____ Month _____ Year _____ Page No.(s) _____
Place of publication, Name of Publisher, Edition, Year, Page (in case of a book) : _____
Library where information is obtained : _____
Call No. _____
Source of bibliographic information : _____
How is it related to the research topic : _____
Additional Comments, if any : _____

You can ideally have two copies of such a bibliographic card. One copy can be arranged according to the authors' names alphabetically whereas the other copy can be arranged as per serial number of the card.

On the other hand, a note card can be of size 4 × 6 or 5 × 7 inches for substantive notes. It is advisable to place only one item of information on each card. Each card can be given a code so as to indicate the place / question / theme / period / person to which the note relates. These cards then can be arranged as per the question, theme, period, place or person under study so as to make analysis easier. In other words, note cards can be kept in multiple copies. (e.g. in triplicate or quadruplicate) depending on the ultimate analysis of the data. Given here is a sample note card.

Main Heading: _____	Card No. _____

Sub – Heading: _____	

Source : Author : _____ Year: _____ pp. _____	
Title: _____ Bibliography card No. _____	

In this card, one can mention the bibliography card no. which can be referred to for further information it required. The reverse of the card can be used if the space is found to be insufficient for necessary information.

(ii) Summary of Quantitative Data:

Usually historical studies are chiefly qualitative in nature since the data obtained includes verbal and / or symbolic material from an institution, society or culture's past. However, when the study involves quantitative data pertaining to the past events, you need to think carefully about the relevance of the data to your research. This is because recording and analysis of quantitative data is time-consuming and sometimes expensive. Examples of quantitative data in historical research include records of students' and teachers' attendance rates, examination results, financial information such as budgets, income and expenditure statements, salaries, fees and so on. Content analysis is one of the methods involving quantitative data. The basic goal of content analysis is to take a verbal, non-quantitative document and transform it into quantitative data.

(iii) Interpretation of Historical Data:

Once the researcher establishes the validity and authenticity of data, interpretation of the facts in the light of the topic of research is necessary. This step requires caution, imagination, ingenuity, insight and scholarliness. The scientific status of his study depends on these characteristics. The researcher needs to be aware of his/her biases, values, prejudices and interest as these could influence the analysis and interpretation of the data as well as the perceptions of the researcher. He needs to make sense out of the multitude of data gathered which generally involves a synthesis of data in relation to a hypothesis or question or theory rather than mere accumulation or summarization. In doing so, he / she should avoid biases and unduly projecting his / her own personality onto the data. The data should be fitted into a logically parsimonious structure. The researcher should be clear about the interpretative framework so as to become sensitive towards bias in other historical researchers' interpretations who have conducted research on the same or similar topics.

In historical research, 'causes' are in the form of antecedents or precipitating factors. They are not 'causes' in the strictly scientific sense. Such antecedents are always complex and hence the researcher should avoid over simplification while interpreting them. Past events are mainly in the form of human behaviour. Therefore 'causes' in historical research could be interpreted in terms of motives of the participants involved.

The researcher needs to identify the motives of the people involved in the event under study while interpreting the data. These motives may be multiple in nature and interact with each other. This makes interpretation of the data a difficult task. For example, a new government decides to change the prevalent textbooks. The motives here could be many such as its political ideology does not match the prevalent textbooks, it had a personal grudge against the authors of the prevalent textbooks or the ministers concerned wanted to derive personal glory out of his actions. These reasons may influence each other making the task of interpretation of data difficult.

Historical researchers can make use of concepts from other social and behavioural science disciplines in analyzing interpreting data. Some examples of such concepts may be bureaucracy, role, institution (from sociology), leadership, institutional effectiveness (From management), culture (from anthropology), motive, personality attitude etc. (from psychology) and so on.

The researcher also can make use of the concepts of historical time and historical space while interpreting the data.

The concept of historical time makes use of a chronology of events. i.e. the researcher needs to identify the chain of events (chronology) of substantive history and then try to understand the meaning of these events, the relationship among the events and the relationship of the events to the research topic. The researcher is studying more than one set of chronological data within the same time frame may gain increased insight into multiple events and their causes.

The concept of historical space deals with ‘where’ the event originated, spread or culminated. This could provide a different insight into the meaning of the data.

The historical researcher can also use analogy as a source of hypothesis or as a frame of reference for interpretation. i.e. He / she can draw parallels between one historical event and other events. Here, one has to be aware of similarities, differences as well as exceptions while comparing two historical events, otherwise, such an extrapolation will be unreliable. Also, it is risky to interpret an event by comparing with another event in another culture at another time.

iv) Making Inferences and Generalizations in Historical Research:

In order to identify and explain the cause/s’ of a historical event, the research must be aware of his/ her assumptions which are then used in ascribing causation to subsequent events. Some examples of such assumption could include (i) history repeats itself, or (ii) historical events are unique. The researcher must make clear whether his / her analysis is based on the former assumption or the latter.

Some examples of ‘causes’ of historical events identified in prior researches include (i) strong ideology (eg. Maharshi Karve’s ideology of women’s education) (ii) actions of certain key persons (e.g. Mohamed Ali Jinnah’s actions for India’s partition), (iii) Advances in Science in technology (e.g. use of computers in education), (iv) economic / geographical / psychological / sociological factors or a combination of all these (e.g. privatization of education) etc.

The historian’s objective is not only to establish facts but also to determine trends in the data and causes of events leading to generalizations i.e. he / she needs to synthesize and interpret and not merely summarize the data. These data, as in other types of researches, are obtained not from the entire population of persons, settings, events or objects pertaining to the topic,

but from a small sample. Moreover, this sample is selected from the remains of the past. It can not be selected from the entire population of documents or relics that existed during the period under study. Such remains may not be representative. This necessitates a very careful and cautious approach in locating consistency in different documents and relics while making generalizations. Also, the researcher should not rely on only one document pertaining to an individual from the past while making a generalization as it will not be known whether the individual held a particular opinion about an educational issue consistently or had changed it over a period of time. If he had changed his opinion, the researcher must find out when and how it was changed, under what conditions and what were the consequences. This makes it imperative that the researcher uses as many primary and secondary sources as possible on a topic. If the evidence is limited, he needs restrict the generalizability of his interpretations to that extent.

E) Writing the Research Report :

This task involves the highest level of scholarship. In a historical research, data collection is flexible. Besides, due to the relative lack of conclusive evidence on which valid generalizations can be established, the writing of historical research has to be a little freer so as to allow subjective interpretation of the data. (This by no means implies distortion of truth). Thus reports of historical research have no standard formats. The presentation of data analysis, interpretations and the findings depend on the nature of the problem.

There are several board ways of reporting historical investigation as follows:

- i) The researcher can report the historical facts as answers to different research questions. Answer to each question could be reported in a separate chapter.
- ii) He / she can present the facts in a chronological order with each chapter pertaining to a specific historical period chronologically.
- iii) Report can also be written in a thematic manner where each chapter deals with a specific theme /topic.
- iv) Chapters could also deal with each state of India or each district of an Indian state separately.
- v) Chapter could also pertain to specific historical persons separately.
- vi) The researcher can also combine two or more of these approaches while writing the research report.

In addition, the report should contain a chapter each on introduction, methodology, review of related literature, findings, the researcher's interpretations and reflections on the interpretative process.

1. Explain how will you identify a research topic for studying the history of education?
2. What are the different sources of historical data? How will you evaluate these sources?
3. What care will you take in making inferences and generalizations in historical research?
4. How will you organize writing the research report?

The researcher needs to demonstrate his / her scholarship and grasp of the topic, his / her insights into the topic, and the plausibility and clarity of interpretations. This requires creativity, ingenuity and imagination so as to make the research report adequate and comprehensive.

4B.8 PROBLEMS AND WEAKNESSES TO BE AVOIDED IN HISTORICAL RESEARCH

Some of the weaknesses, problems and mistakes that need to be avoided in historical research are as follows:

1. The problem of research should not be too broad.
2. It should be selected after ensuring that sources of data are existent, accessible and in a language known to the researcher.
3. Excessive use of easy-to-find secondary sources of data should be avoided. Though locating primary sources of data time- consuming and requires efforts, they are usually more trustworthy.
4. Adequate internal and external criticism of sources of historical data is very essential for establishing the authenticity and validity of the data. It is also necessary to ascertain whether statements concerning evidence by one participant have influenced opinions of other participant or witnesses.
5. The researcher needs to be aware of his/her own personal values, interests and biases. For this purpose, it is necessary for the researcher to quote statements along with the context in which they were made. Lifting them out of context shows the intention of persuading the readers. The researcher also needs to avoid both-extreme generosity or admiration as well as extreme criticism. The researcher needs to avoid reliance on beliefs such as “old is gold” “new is always better” or “change implies progress” . All such beliefs indicate researcher’s bias and personal values.
6. The researcher needs to ensure that the concepts borrowed from other disciplines are relevant to his/her topic.
7. He/She should avoid unwarranted causal inferences arising on account

of (i) oversimplification (causes of historical event may be multiple, complex and interactive), (ii) Faulty interpretation of meanings of words, (iii) inability to distinguish between facts, opinions and situations, (iv) inability to identify and discard irrelevant or unimportant facts and (v) Faulty generalization based on inadequate evidence, faulty logic and reasoning in the analysis of data, use of wrong analogy and faulty comparison of events in unsimilar cultures.

8. The researcher needs to synthesize facts into meaningful chronological and thematic patterns.
9. The report should be written in a logical and scientific manner. It should avoid flowery or flippant language, emotional words, dull and colourless language or persuasive style.
10. The researcher should avoid projecting current problems onto historical events as this is likely to create historians.

4B.9 CRITERIA OF EVALUATING HISTORICAL RESEARCH:

Mouly has provided the following criteria of evaluating historical research:

1. **Problem:** Has the problem been clearly defined? It is difficult enough to conduct historical research adequately without adding to the confusion by starting out with a nebulous problem. Is the problem capable of solution? Is it within the competence of the investigator?
2. **Data:** Are data of a primary nature available in sufficient completeness to provide a solution, or has there been an overdependence on secondary or unverifiable sources?
3. **Analysis:** Has the dependability of the data been adequately established? Has the relevance of the data been adequately explored?
4. **Interpretation:** 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 objective or does he allow personal bias to distort the evidence? Are his hypotheses plausible? Have they been adequately tested? Does he take a sufficiently broad view of the total situation? Does he see the relationship between his data and other 'historical facts'?
5. **Presentation:** 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, or is it simply 'uninspired back work'? Does it reflect scholarliness?

Check your Progress III

1. What care will you take to avoid weaknesses in conducting historical research?
2. State the criteria of evaluating historical research.

Suggested Readings:

- Garraghan, G. J. A Guide to Historical Method. New York: Fordham University Press. 1946.
- Gottschalk, L. Understanding History. New York : Alfred A. Knopf. 1951.
- McMillan, J. H. and Schumacher, S. Research in Education : A Conceptual Introduction. Boston, MA : Little, brown and Company. 1984.
- Shafer, R. J. A Guide to Historical Method. Illinois : The Dorsey Press. 1974.



QUANTITATIVE AND QUALITATIVE RESEARCH-III (EXPERIMENTAL DESIGN)

Unit Structure

4C.0 Objectives

4C.1 Introduction

4C.2 Experimental Designs

4C.3 Factorial Design

4C.4 Nested Design

4C.5 Single Subject Design

4C.6 Internal and External Experimental Validity

4C.7 Unit End Exercise

4C.0 OBJECTIVES:

After going through this module, you will be able to:

- Conceptualize experimental method of educational research;
- Describe the salient features of experimental research; on
- Conceptualize various experimental design
- Conceptualize the internal and external experimental validity
- Conceptualize the process of controlling the intervening and extraneous variables; and
- Apply experimental method for appropriate research problem.

4C.1 INTRODUCTION:

The experimental method in educational research is the application and adaptation of the classical method of experimentation. It is a scientifically sophisticated method. It provides a method of investigation to derive basic relationships among phenomena under controlled condition or, more simply, to identify the conditions underlying the occurrence of a given phenomenon. Experimental research is the description and analysis of what will be, or what will occur, under carefully controlled conditions.

Experimenters manipulate certain stimuli, treatments, or environmental conditions and observe how the condition or behaviour of the subject is affected or changed. Such manipulations are deliberate and systematic. The researchers must be aware of other factors that could influence the outcome and remove or control them in such a way that it will establish a logical association between manipulated factors and observed factors.

Experimental research provides a method of hypothesis testing. Hypothesis is the heart of experimental research. After the experimenter defines a problem he has to propose a tentative answer to the problem or hypothesis. Further, he has to test the hypothesis and confirm or disconfirm it.

Although, the experimental method has greatest utility in the laboratory, it has been effectively applied non-laboratory settings such as the classroom. The immediate purpose of experimentation is to predict events in the experimental setting. The ultimate purpose is to generalize the variable relationships so that they may be applied outside the laboratory to a wider population of interest.

Characteristics of Experimental Method

There are four essential characteristics of experimental research: (i) Control, (ii) Manipulation (iii) Observation, and (iv) Replication.

Control: Variables that are not of direct interest to the researcher, called extraneous variables, need to be controlled. Control refers to removing or minimizing the influence of such variables by several methods such as: randomization or random assignment of subjects to groups; matching subjects on extraneous variable(s) and then assigning subjects randomly to groups; making groups that are as homogenous as possible on extraneous variable(s); application of statistical technique of analysis of covariance (ANCOVA); balancing means and standard deviations of the groups.

Manipulation: Manipulation refers to a deliberate operation of the conditions by the researcher. In this process, a pre-determined set of conditions, called independent variable or experimental variable. It is also called treatment variable. Such variables are imposed on the subjects of experiment. In specific terms manipulation refers to deliberate operation of independent variable on the subjects of experimental group by the researcher to observe its effect. Sex, socio-economic status, intelligence, method of teaching, training or qualification of teacher, and classroom environment are the major independent variables in educational research. If the researcher, for example, wants to study the effect of 'X' method of teaching on the achievement of students in mathematics, the independent variable here is the method of teaching. The researcher in this experiment needs to manipulate 'X' i.e. the method of teaching. In other words, the researcher has to teach the experimental groups using 'X' method and see its effect on achievement.

Observation : In experimental research, the experimenter observes the effect of the manipulation of the independent variable on dependent

variable. The dependent variable, for example, may be performance or achievement in a task.

Replication : Replication is a matter of conducting a number of sub-experiments, instead of one experiment only, within the framework of the same experimental design. The researcher may make a multiple comparison of a number of cases of the control group and a number of cases of the experimental group. In some experimental situations, a number of control and experimental groups, each consisting of equivalent subjects, are combined within a single experiment.

Check your progress – 1

What are the characteristics of experimental research?

4C.2 EXPERIMENTAL DESIGNS:

Experimental design is the blueprint of the procedures that enable the researcher to test hypotheses by reaching valid conclusions about relationships between independent and dependent variables (Best, 1982, p.68). Thus, it provides the researcher an opportunity for the comparison as required in the hypotheses of the experiment and enables him to make a meaningful interpretation of the results of the study. The designs deal with practical problems associated with the experimentation such as: (i) how subjects are to be selected for experimental and control groups, (ii) the ways through which variables are to be manipulated and controlled, (iii) the ways in which extraneous variables are to be controlled, how observations are to be made, and (iv) the type of statistical analysis to be employed.

Variables are the conditions or characteristics that the experimenter manipulates, controls, or observes. The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to study their relationships to the observed phenomena. The dependent variables are the conditions or characteristics that appear or disappear or change as the experimenter introduces, removes or changes the independent variable. In educational research teaching method is an example of independent variable and the achievement of the students is an example of dependent variable. There are some confounding variables that might influence the dependent variable. Confounding variables are of two types; intervening and extraneous variables. Intervening variables are those variables that cannot be controlled or measured but may influence the dependent variable. Extraneous variables are not manipulated by the researcher but influence the dependent variable. It is impossible to eliminate all extraneous variables, but sound experimental design enables the researcher to more or less neutralize their influence on dependent variables.

There are various types of experimental designs. The selection of a particular design depends upon factors like nature and purpose of experiment, the type of variables to be manipulated, the nature of the data,

the facilities available for carrying out the experiment and the competence of the experimenter. The following categories of experimental research designs are popular in educational research:

- (i) Pre-experimental designs – They are least effective and provide little or no control of extraneous variables.
- (ii) True experimental designs – employ randomization to control the effects of variables such as history, maturation, testing, statistical regression, and mortality.
- (iii) Quasi-experimental designs – provide less satisfactory degree of control and are used only when randomization is not feasible.
- (iv) Factorial designs- more than one independent variables can be manipulated simultaneously. Both independent and interaction effects of two or more than two factors can be studied with the help of this factorial design.

Symbols used :

In discussing experimental designs a few symbols are used. E – Experimental group

C – Control group

X – Independent variable Y – Dependent variable

R – Random assignment of subjects to groups

Y_b – Dependent variable measures taken before experiment / treatment (pre-test)

Y_a – Dependent variable measures taken after experiment/ treatment (Post-test)

M_r – Matching subjects and then random assignment to groups.

a. Pre-Experimental design:

There are two types of pre-experimental designs:

1. The one group pre-test post-test design:

This is a simple experimental research design without involvement of a control group. In this design the experimenter takes dependent variable measures (Y_b) before the independent variable

(X) is manipulated and again takes its measures (Y_a) afterwards: The difference if any, between the two measurements (Y_b and Y_a) is computed and is ascribed to the manipulation of X.

Pre-test Independent variable Post-test

Y_b X Y_a

The experimenter, in order to evaluate the effectiveness of computer-based instruction (CBI) in teaching of science to grade V students, administers an achievement test to the whole class (Y_b) before teaching through CBI. The test is administered over the same class again to measure Y_a . The means of Y_b and Y_a are compared and the difference if any is ascribed to effect of X, i.e. teaching through CBI.

The design has the inherent limitation of using one group only. The design also lacks scope of controlling extraneous variables like history, maturation, pre-test sensitization, and statistical regression etc.

2. The two groups static design:

This design provides some improvement over the previous by adding a control group which is not exposed to the experimental treatment. The experimenter may take two sections of grade-V of one school or grade-V of one school or grade-V students of two different schools (intact classes) as experimental and control groups respectively and assume the two groups to be equivalent. No pre-test is taken to ascertain it.

Group	Independent Variable	Post-test
E	X	Y_a
C	-	Y_a

This design compares the post-test scores of experimental group (Y_a E) that has received experimental treatment (X) with that of control group (Y_a C) that has not received X.

The major limitation of the design is that there is no provision for establishing the equivalence of the experimental (E) and control (C) groups. However, since no pretest is used, this design controls for the effects of extraneous variables such history, maturation, and pre-testing.

Check your progress – 2

What is pre-experimental design.?

b. Quasi-Experimental Design:

Researchers commonly try to establish equivalence between the experimental and control groups, the extent they are successful in doing so; to this extent the design is valid. Sometimes it is extremely difficult or impossible to equate groups by random selection or random assignment, or by matching. In such situations, the researcher uses quasi-experimental design.

The Non-Equivalent Groups Design is probably the most frequently used design in social research. It is structured like a pretest-posttest randomized experiment, but it lacks the key feature of the randomized designs -- random assignment. In the Non- Equivalent Groups Design, we most often use intact groups that we think are similar as the treatment and

control groups. In education, we might pick two comparable classrooms or schools. In community-based research, we might use two similar communities. We try to select groups that are as similar as possible so we can fairly compare the treated one with the comparison one. But we can never be sure the groups are comparable. Or, put another way, it's unlikely that the two groups would be as similar as they would if we assigned them through a random lottery. Because it's often likely that the groups are not equivalent, this design was named the nonequivalent group design to remind us.

Pre-test	Independent Variable	Post-test
Y_b	X	Y_a (Experimental)
Y_b	-	Y_a (Control)

So, what does the term "nonequivalent" mean? In one sense, it just means that assignment to group was not random. In other words, the researcher did not control the assignment to groups through the mechanism of random assignment. As a result, the groups may be different prior to the study. This design is especially susceptible to the internal validity threat of selection. Any prior differences between the groups may affect the outcome of the study. Under the worst circumstances, this can lead us to conclude that our program didn't make a difference when in fact it did, or that it did make a difference when in fact it didn't.

The counterbalanced design may be used when the random assignment of subject to experimental group and control group is not possible. This design is also known as rotation group design. In counterbalanced design each group of subject is assigned to experimental treatment at different times during the experiment. This design overcomes the weakness of non-equivalent design. When intact groups are used, rotation of groups provides an opportunity to eliminate any differences that might exist between the groups. Since all the groups are exposed to all the treatments, the results obtained cannot be attributed to the preexisting differences in the subjects. The limitation of this design is that there is carry-over effect of the groups from one treatment to the next. Therefore, this design should be used only when the experimental treatments are such that the administration of one treatment on a group will have no effect on the next treatment. There is possibility of boring students with repeated testing.

Check your progress – 3

How does pre-experimental design differ from quasi experimental design?

c. TRUE EXPERIMENTAL DESIGN:

True experimental designs are used in educational research because they ascertain equivalence of experimental and control groups by random assignment of subjects to these groups, and thus, control the effects of extraneous variables like history, maturation, testing, measuring

instruments, statistical regression and mortality. This design, in contrast to pre-experimental design, is a better and used in educational research wherever possible.

1. Two groups, randomized subjects, post-test only design:

This is one of the most effective designs in minimizing the threats to experimental validity. In this design subjects are assigned to experimental and control groups by random assignment which controls all possible extraneous variables, e.g. testing, statistical regression, mortality etc. At the end of experiment the difference between the mean post-test scores of the experimental and control group are put to statistical test –‘t’ test or analysis of variance (ANOVA). If the differences between the means are found significant, it can be attributed to the effect of (X), the independent variable.

	Group	Independent Variable	Post-test
R	E	X	Y_a
	C	-	Y_a

The main advantage of this design is random assignment of subjects to groups, which assures the equivalence of the groups prior to experiment. Further, this design, in the absence of pretest, controls the effects of history, maturation and pre-testing etc.

This design is useful in the experimental studies at the pre- primary or primary stage and the situations in which a pre-test is not appropriate or not available.

2. Two groups, randomized matched subject, post-test only design :

This design, instead of using random assignment of subjects to experimental and control group, uses the technique of matching. In this technique, the subjects are paired so that their scores on matching variable(s), i.e. the extraneous variable(s) the experimenter wants to control, are as close as possible. One subject of each pair is randomly assigned to one group and the other to the second group. The groups are designated as experimental and control by random assignment (tossing a coin).

	Group	Independent Variable	Post-test
MR	E	X	Y_a
	C	-	Y_a

This design is mainly used where —two groups randomized subjects, post-test only design is not applicable and where small groups are to be used. The random assignment of subjects to groups after matching adds to the strength of this design. The major limitation of the design is that it is very difficult to use matching as a method of controlling extraneous variables because in some situations it is not possible to locate a match and some subjects are excluded from the experiment.

3. Two groups randomized subjects, pre-test post-test design:

In this design subjects are assigned to the experimental group and the control group at random and are given a pre-test (Y_b). The treatment is introduced only to the experimental group, after which the two groups are measured on dependent variable. The difference in scores or gain scores (D) in respect of pre-test and post-test ($Y_a - Y_b = D$) is found for each group and the difference in scores of both the groups (D_e and D_c) is compared in order to ascertain whether the experimental treatment produced a significant change. Unless the effect of the experimental manipulation is strong, the analysis of the differential score is not advisable (Kerlinger, 1973, p-336). If they are analyzed, however, a t' or F' test issued.

Group	Pre-test	Independent Variable	Post-test
E	Y_b	X	Y_a
C	Y_b	-	Y_a

The main advantages of this design include:

- Through initial randomization and pre-testing equivalence between the two groups can be sure.
- Randomization seems to control most of the extraneous variables.

But the design does not guarantee external validity of the experiment as the pretest may increase the subjects' sensitivity to the manipulation of X.

4. The Solomon three groups design:

This design, developed by Solomon seeks to overcome the difficulty of the design: Randomized Groups, Pre-test Posttest Design, i.e. the interactive effects of pre-testing and the experimental manipulation. This is achieved by employing a second control group (C_2) which is not pre-tested but is exposed to the experimental treatment (X).

Group	Pre-test	Independent Variable	Post-test
E	Y_b	X	Y_a
C_1	Y_b	-	Y_a
C_2	-	X	Y_a

This design provides scope for comparing post-tests (Y_a) scores for the three groups. Even though the experimental group has a significantly higher mean score as compared to that of the first control group ($Y_a E > Y_a C_1$), one cannot be confident that this difference is due to the experimental treatment (X). It might have occurred because of the subjects' pre-test sensitization. But, if the mean Y_a scores of the second control group is also higher as compared to that of the first control group ($Y_a C_2 > Y_a C_1$), then one can assume that the experimental treatment has produced the difference rather than the pre-test sensitization, since C_2 is not pre- tested.

5. The Solomon four group design:

This design is an extension of Solomon three group design and is really a combination of two two-groups designs: (i) Two groups randomized subjects pre-test post-test design; and (ii) Two group randomized subjects post-test only design. This design provides rigorous control over extraneous variables and also provides opportunity for multiple comparisons to determine the effects of the experimental treatment(X).

In this design the subjects are randomly assigned to the four groups. One experimental (E) and three control (C_1 , C_2 and C_3). The experimental and the first control group (E and C_1) are pre-tested groups, and the second and third control groups (C_2 and C_3) are not pre-tested groups. If the post-test mean scores of experimental group ($Y_a E$) is significantly greater than the post-test mean score of the first control group ($Y_a C_1$); and also the post test mean score of the second control group ($Y_a C_2$) is significantly greater than the post-test mean score of the third control group ($Y_a C_3$), the experimenter arrives at the conclusion that the experimental treatment (X) has effect.

Group	Pre- test	Independent Variable	Post test
E	Yb	X	Ya
C1	Yb	-	Ya
R			
C2	-	X	Ya
C3	-	-	Ya

This design is considered to be strong one as it actually involves conducting the experiment twice, once with pre-test and once without pre-test. Therefore, if the results of these two experiments are in agreement, the experimenter can have much greater confidence in his findings. The design seems to have two sources of weakness. One is practicability as it is difficult to conduct two simultaneous experiments, and the researcher encounters the difficulty of locating more subjects of the same kind. The

other difficulty is statistical. Since the design involves four sets of measures for four groups and the experimenter has to make comparison between the experimental and first control group and between second and third control groups there is no single statistical procedure that would make use of the six available measures simultaneously.

Check your progress – 4

1. How does true experimental design differ from quasi experimental design?

4C.3 FACTORIAL DESIGN:

Experiments may be designed to study simultaneously the effects of two or more variables. Such an experiment is called factorial experiment. Experiments in which the treatments are combinations of levels of two or more factors are said to be factorial. If all possible treatment combinations are studied, the experiment is said to be a complete factorial experiment. When two independent factors have two levels each, we call it as 2x2 (spoken "two-by-two") factorial design. When three independent factors have two levels each, we call it 2x2x2 factorial design. Similarly, we may have 2x3, 3x3, 3x4, 3x3x3, 2x2x2x2, etc.

Simple Factorial Design :

A simple factorial design is 2x2 factorial design. In this design there are two independent variables and each of the variables has two levels. One advantage is that information is obtained about the interaction of factors. Both independent and interaction effects of two or more than two factors can be studied with the help of this factorial design.

In factorial designs, a **factor** is a major independent variable. In this example we have two factors: methods of teaching and intelligence level of the students. A **level** is a subdivision of a factor. In this example, method of teaching has two levels and intelligence has two levels. Sometimes we depict a factorial design with a numbering notation. In this example, we can say that we have a 2x

2 (spoken "two-by-two") factorial design. In this notation, the number of numbers tells us how many factors there are and the number values tell how many levels. The number of different treatment groups that we have in any factorial design can easily be determined by multiplying through the number notation. For instance, in our example we have $2 \times 2 = 4$ groups. In our notational example, we would need $3 \times 4 = 12$ groups. Full factorial experiment is an experiment whose design consists of two or more factors, each with discrete possible values or "levels", and whose experimental units take on all possible combinations of these levels across all such factors. A full factorial design may also be called a fully-crossed design. Such an experiment allows studying the effect of each factor on the response variable, as well as the effects of interactions between factors on the response variable.

For the vast majority of factorial experiments, each factor has only two levels. For example, with two factors each taking two levels, a factorial experiment would have four treatment combinations in total, and is usually called a 2x2 factorial design. The first independent variable, which is manipulated, has two values called the experimental variable. The second independent variable, which is divided into levels, may be called control variable. For example, there are two experimental treatments, that is, teaching through co-operative learning and teaching through lecture method. It is observed that there may be differential effects of these methods on different levels of intelligence of the students. On the basis of the IQ score the experimenter divides the students into two groups: one high intelligent group and the other the low intelligent group. There are four groups of students within each of the two levels of

	High Intelligence Group	Low Intelligence Group
Teaching Through Co-operative Learning Method	Gain Score on the Dependent Variable	Gain Score on the Dependent Variable
Teaching Through Lecture Method	Gain Score on the Dependent Variable	Gain Score on the Dependent Variable

Since one of the objectives is to compare various combinations of these groups, the experimenter has to obtain the mean scores for each row and each column. The experimenter can first study the main effect of the two independent variables and the interaction effect between the intelligence level and teaching method.

Check your progress – 5

1. How does factorial design differ from true experimental design?

4C.4 NESTED DESIGN:

In a nested design, each subject receives one, and only one, treatment condition. In a nested design, the levels of one factor appear only within one level of another factor. The levels of the first factor are said to be nested within the level(s) of the second factor. When variables such as race, income and education, etc. may be found only at a particular level of the independent variable, these variables are called nested variables. In these studies the various nested variables are grouped for the study. For example, a researcher is studying school effectiveness with academic achievement of students as the indicator or criterion variable. In this type

of research, school type can be nested within individual schools which can be nested within classrooms. The major distinguishing feature of nested designs is that each subject has a single score. The effect, if any, occurs between groups of subjects and thus the name “**Between Subjects**” is given to these designs. The relative advantages and disadvantages of nested designs are opposite those of crossed designs. First, carry over effects are not a problem, as individuals are measured only once. Second, the number of subjects needed to discover effects is greater than with crossed designs. Some treatments by their nature are nested. The effect of gender, for example, is necessarily nested. One is either a male or a female, but not both. Religion is another example. Treatment conditions which rely on a pre-existing condition are sometimes called demographic or blocking factors.

Crossed Design :

In a crossed design each subject sees each level of the treatment conditions. In a very simple experiment, such as one that studies the effects of caffeine on alertness, each subject would be exposed to both a caffeine condition and a no caffeine condition. For example, using the members of a statistics class as subjects, the experiment might be conducted as follows. On the first day of the experiment, the class is divided in half with one half of the class getting coffee with caffeine and the other half getting coffee without caffeine. A measure of alertness is taken for each individual, such as the number of yawns during the class period. On the second day the conditions are reversed; that is, the individuals who received coffee with caffeine are now given coffee without and vice-versa. The size of the effect will be the difference of alertness on the days with and without caffeine.

The distinguishing feature of crossed designs is that each individual will have more than one score. The effect occurs within each subject, thus these designs are sometimes referred to as within subjects’ designs.

Crossed designs have two advantages. One, they generally require fewer subjects, because each subject is used a number of times in the experiment. Two, they are more likely to result in a significant effect, given the effects are real.

Crossed designs also have disadvantages. One, the experimenter must be concerned about carry-over effects. For example, individuals not used to caffeine may still feel the effects of caffeine on the second day, even though they did not receive the drug. Two, the first measurements taken may influence the second. For example, if the measurement of interest was score on a statistics test, taking the test once may influence performance the second time the test is taken. Three, the assumptions necessary when more than two treatment levels are employed in a crossed design may be restrictive.

Check your progress - 6

1. What is the difference between nested design and crossed design?

4C.5 SINGLE FACTOR EXPERIMENT:

Many experiments involve single treatment or variable with two or more levels. First, a group of experimental subjects may be divided into independent groups, using a random method. Different treatment may be applied to each group. One group may be a control group, a group to which no treatment is applied. For meaningful interpretation of experiment, results obtained under treatment may be compared with results obtained in the absence of treatment. Comparison may be made between treatments and between treatment and a control.

Some single factor experiments involve a single group of subjects. Each subject receives treatments. Repeated observations or measurements are made on the same subjects.

Some single factor experiments may consists of groups that are matched on one or more variables which are known to be correlated with the dependent variable. For example IQ may be correlated with achievement.

An example of single factor Experiment :

It is believed that the amount of time a player warms up at the beginning will have a significant impact on his game, lawn tennis. The hypothesis is that if he does not warm up at all or only for a brief time (less than 15 minutes), he will be stiff and his score will be poor. However, if he warms up too much (over 40 minutes), he will be tired and his game score will also suffer. He needs to choose levels of warming up to test this hypothesis that are significantly different enough. The levels he will test are warming up for 0, 15, 30, and 45minutes.

4C.6 INTERNAL AND EXTERNAL EXPERIMENTAL VALIDITY:

Validity of experimentation :

An experiment must have two types of validity: internal validity and external validity (Campbell and Stanley, 1963):

Internal validity :

Internal validity refers to the extent to which the manipulated or independent variables actually have a genuine effect on the observed results or dependent variable and the observed results were not affected by the extraneous variables. This validity is affected by the lack of control of extraneous variables.

External validity :

External validity is the extent to which the relationships among the variables can be generalized outside the experimental setting like other population, other variables. This validity is concerned with the

generalizability or representative ness of the findings of experiment, i.e. to what population, setting and variables can the results of the experiment be generalized.

Factors affecting validity of experimentation :

In educational experiments, a number of extraneous variables influence the results of the experiment in way that are difficult to evaluate. Although these extraneous variables cannot be completely eliminated, many of them can be identified. Campbell and Stanley (1963) have pointed out the following major variables which affect significantly the validity of an experiment:

History :The variables, other than the independent variables, that may occur between the first and the second measurement of the subjects (Pre-test and post test).

Maturation :The changes that occur in the subjects over a period of time and confused with the effects of the independent variables.

Testing :Pre-testing, at the beginning of an experiment, may be sensitive to subjects, which may produce a change among them and may affect their post-test performance.

Measuring Instruments :Different measuring instruments, scorers, interviewers or the observers used at the pre and post testing stages; and unreliable measuring instruments or techniques are threats to the validity of an experiment.

Statistical regression :It refers to the tendency for extreme scores to regress or move towards the common mean on subsequent measures. The subjects who scored high on a pre-test are likely to score relatively low on the retest whereas the subjects who scored low on the pre-test are likely to score high on the retest.

Experimental mortality :It refers to the differential loss of subjects from the comparison groups. Such loss of subjects may affect the findings of the study. For example, if some subjects in the experimental group who received the low scores on the pre-test drop out after taking the test, this group may show higher mean on the post-test than the control group.

Differential selection of subjects :It refers to difference between/among groups on some important variables related to the dependent variable before application of the experimental treatment.

Check your progress – 7

1. What is experimental validity?

4C.7 UNIT END EXERCISE:

- Differentiate between the true experimental designs and factorial design.
- Differentiate between internal and external validity.
- What is the significance of randomization in experimental research?

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TOOLS AND TECHNIQUES OF RESEARCH-I

(PREPARATION OF TOOL)

Unit Structure

5A.0 Classical test theory and Item Response Theory of test construction

5A.1 Steps of Preparing a Research Tool

5A.2 Validity

5A.3 Types of Validity

5A.4 Factors affecting validity

5A.5 Reliability

5A.6 The methods of Estimating Reliability

5A.7 Factors affecting Reliability

5A. 8 Item Analysis

5A.9 Steps involved in Item –Analysis

5A.10 Standardization of a tool

5A.0 CLASSICAL TEST THEORY AND ITEM RESPONSE THEORY OF TEST CONSTRUCTION

Measurements is the process of quantifying the attributes, traits, characteristics of a concept or construct.

Theories of measurement or test help us in understanding and answering some important questions like does the test work? Does the test measure what it is expected to measure? Why a test does behaves in a particular way? etc. They help us in interpretation of the test scores, evaluate how good/bad the test is and influence of the distracters. They help in interpreting and treating the test results mathematically or statistically.

Two widely used test theories are **Classical Test Theory (CTT)** and **Item Response Theory**.

Classical test theory is the most widely used theory in the field of psychology and education. It is also called as true score theory. It can be summed up in the form of following equation:

$$X=T+E$$

Where,

X = observed score

T = true score

E = Random Error

The aim of this theory is to improve the tests specifically in terms of validity and reliability of tests. This theory is based on the assumption that each person has a true score.

CTT talks about three basic concepts i.e. test score, error and true score. Test score refers to observed score. e.g. If you get 35 marks in English test, 35 is your test score. Error refers to the amount of error found in a test or measure or extraneous factors which we cannot control but affect the outcome. True score refers to the score

that would be obtained if there is no error in the measurement or a test. True scores quantify the attributes of a concept or construct. When the value of the true score increases the response to the item representing that same concept is expected to increase. It is assumed that the error is

- i) Normally distributed
- ii) Uncorrelated with true zero
- iii) Has a mean of zero

Item Response Theory:

Item response theory (IRT), also known as latent trait theory, is more recent theory. It was created to understand how individuals respond to individual items in a psychological or educational test. It focuses more on items of the tests. The theory attempts to explain the relationship between the latent traits (unobservable characteristics or attributes) and their manifestation (observed behavior, response, performance). It tries to establish relationship between properties of item in a test, responders and underlying or latent trait that is being measured. It makes stronger assumptions as compared to CTT.

Though it is theoretically possible, practically it is not feasible to use this theory without specialized software as it uses complex statistical algorithms. The models of IRT are framed according to the probability of a respondent to respond in a specific manner to a test item, because of specific underlying behavior. Along with the person's level of construct, item difficulty, item discrimination and guessing affect the response to a particular test item. The simplest models of IRT are based on the item difficulty and the complex ones consider the other two or more parameters.

Difference between Classical test theory and item response theory (Ref. Hambleton, R.K. & Jones, R.W., 1993):

Tools and Techniques of Research-I

Classical Test Theory (CTT)	Item Response Theory (IRT)
Most widely used approach	Gaining more popularity
Considers general performance of the test	Useful for developing advanced test (computer adaptive testing)
Works at test level	Works at item level
Challenging but comprehensible	Complex and nonlinear models
Better for smaller samples (N=100-300)	Better for larger samples (N= 500+)
Items are standardized on a given sample	Knowledge about an item is independent of sample on which it is tested.
Simpler mathematical analysis compared to IRT	Scores describe examinee proficiency that are not dependent on test difficulty.
Estimation of model is conceptually straightforward	Estimation is complex
Techniques is robust, minimal assumptions	More stringent assumptions

5A.1 STEPS OF CONSTRUCTING A RESEARCH TOOL:

The three major stages of a tool construction are:

- 1. Developing pool of items**
- 2. Item analysis- computing difficulty index and discrimination index**
- 3. Ascertaining validity**

These three stages could be discussed in details under following steps:

Step I. Planning:

1. Deciding the nature, objective, and purpose of the test.

It is essential to know the test's purpose before constructing it. Is it meant to test cognitive levels?, categorize the participants in different groups based on particular criteria?, or test the skills? Keeping the purpose and nature of the test in mind, the researcher would create test items.

2. Determine the weightage to different objectives (e.g., knowledge, understanding, application, skill for an achievement test) and different aspects of the construct depending on operational definition.

The researcher needs to determine the weightage to different objectives. The selected test items need to test the attainment of those objectives.

3. Determine the weightage to different content areas.

What content to be covered should be decided, and the items should be created keeping the selected content in mind.

4. Determine the test's item types (MCQs, long answers, short answers, statements for rating, check list etc.).

Depending on the purpose and objectives and nature of the construct, the decision should be taken about the type of questions in the test.

5. Prepare a blueprint keeping all the dimensions in mind

6. Deciding the technical aspects like test size, printing, font size, time duration, etc.

Decide the length of the test, specifications of paper for printing, size of letters to be used, and time to be allotted for taking the test.

7. Instructions for scoring and administering the test.

A detailed manual to be prepared with all the necessary instructions related to the test's scoring. How to score the different items (positive items, negative items, easy items, difficult items), calculate final scores, convert the scores (if any convergence is required) should be clearly stated. Detailed instructions should be provided for administering the test like number of participants, seating arrangement (if a specific arrangement is required), how to greet, what and how to instruct them should be given in the manual.

8. Determine the weightage to different categories of the difficulty level of items.

Decide what type of questions will carry how many marks. As per the items' difficulty levels, varied weightage could be assigned to each item.

Step II. Preparing the test:

Following the blueprint, the test items should be created. While preparing a standardized test, one has to be very careful. Hence, sufficient time should be devoted to the create test items considering all the dimensions of the blueprint.

While constructing these test items, one needs to perform the following tasks:

1. **Test items preparation:** It is the most crucial task in constructing a test. The test items should be clear, comprehensive, and free from ambiguity. Appropriate vocabulary should be used for the test items. Sufficient test items should be created as the number may reduce after initial scrutiny. After the items are created, they need to be arranged in an

appropriate sequence, and if different forms of questions are being used, they need to be grouped in different categories or sections.

2. Writing instructions about test items:

According to Gronlund, a test creator, generally the researcher, should provide clear guidelines about the purpose of testing, time allotted for testing, the basis of answering, the procedure for recording answers, and methods to deal with guessing.

3. Directions about the administration of the test:

Detailed direction for the administration of the test is to be provided. The conditions under which the test should be administered, when to administer (middle of the session or in the end?), what time frame to be followed, additional material (if required), precautions to be taken while administering the test, etc. stated clearly.

4. Directions for scoring

A scoring key should be provided to facilitate objectivity in scoring. Question-wise scoring key and marking scheme should be provided.

5. Question-wise chart:

A question-wise analysis chart should be prepared. This chart should clearly describe the content area covered, the objective it intends to measure, type, marks allotted, difficulty level, and time required to answer it.

Step III. Pilot testing:

After constructing the test, it is essential to try it out on a smaller scale. The purpose is to improve the test. Trying out a test helps identify defective or ambiguous items, defects in administering the test, identifying bad distractors, providing data for determining the difficulty level and discriminatory value of the item, determining the number of items for the final test, and determining the time frame.

Trying out a test is carried out in three phases:

Phase 1: Administer the test on a small sample (10-15)

The feasibility of the items is observed at this stage. Based on the observations, the test items are improved/ modified.

Phase 2: Administer on a more significant sample (around 50).

This phase aims to select good test items and drop the poor ones. This phase includes two activities; item analysis and preparing the final draft of the test.

- a) Item analysis: carry out item analysis for the following three parameters
 - i) Item difficulty
 - ii) Item discrimination
 - iii) Effectiveness of distracters
- b) Preparing final draft: after item analysis, items satisfying all the criteria for the test are included in the final draft of the test.

Phase 3: Administer on a large sample (400)

This phase aims to estimate the reliability and validity of the test.

Step IV. Evaluating the test:

Standardization and evaluation of the test is done as follows:

1. The final test and answer sheet is printed.
2. The test's duration is determined by taking the average of three groups of participants; bright, average, and below average.
3. Instructions are printed for administering the test
4. Score are tabulated and measures of central tendency; mean, mode, median, SD are calculated.
5. The obtained scores are plotted and checked for normality of distribution, and various percentile scores are calculated. Scores like T-score, Z-score are estimated. Norms like age, sex, rural-urban, etc. are calculated as required.
6. Validity of the test score is estimated by correlating the scores with some other criterion. Construct validity is found out using factor analysis.
7. For evaluating the newly constructed test, reliability is determined using the split-half method or rational equivalence. The test reliability can be estimated by using the test-retest method.
8. How feasible and usable the test is determined from scoring, time, and economic point of view. All the required norms are to be provided to facilitate the interpretation of scores.

5A.2 VALIDITY:

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

(i) Validity :Validity is the most important consideration in the selection and use of any testing procedures. The validity of a test, or of any

measuring instrument, depends upon the degree of exactness with which something is reproduced/copied or with which it measures what it purports to measure.

The validity of a test may be defined as “the accuracy with which a test measures what it attempts to measure.” It is also defined as “The efficiency with which a test measures what it attempts to measure”. Lindquist has defined validity – “As the accuracy with which it measures that which is intended to as the degree to which it approaches infallibility in measuring what it purports to measure”.

On the basis of the preceding definitions, it is seen that

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

5A.3 TYPES OF VALIDITY:

(i) Content Validity: According to Anastasi (1968), “content validity involves essentially the systematic examination of the text content to determine whether it covers a representative sample of the behaviour domain to be measured”. It refers to how well our tool sample represents the universe of criterion behaviour. Content validity is employed in the selection of items in research tools. The validation of content through competent judgments is satisfactory when the sampling of items is wide and judicious.

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

There are two forms of criterion-related validity.

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

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

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

5A.4 FACTORS AFFECTING VALIDITY:

The following points influence the validity of a test :

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

- (II) **Vocabulary** :If the vocabulary of the respondent is poor, the he/she fails to respond to the tool item, even if he/she knows the answer. It becomes a reading comprehension text for him/her, and the validity decreases.
- (III) **Difficult Sentence Construction** :If a sentence is so constructed as to be difficult to understand, respondents would be confused, which will affect the validity of the tool.
- (IV) **Poorly Constructed Test Items**: These reduce the validity of a test.
- (V) **Use of Inappropriate Items** :The use of inappropriate items lowers validity.
- (VI) **Difficulty Level of Items** :In an achievement test, too easy or too difficult test items would not discriminate among students. Thereby the validity of a test is lowered.
- (VII) **Influence of Extraneous Factors**: Extraneous factors like the style of expression, legibility, mechanics of grammar, (Spelling, punctuation) handwriting, length of the tool, influence the validity of a tool.
- (VIII) **Inappropriate Time Limit** :In a speed test, if no time limit is given the result will be invalidated. In a power test, an inappropriate time limit will lower its validity. Our tests are both power and speed tests. Hence care should be taken in fixing the time limit.
- (IX) **Inappropriate Coverage** :If the does not cover all aspects of the construct being measured adequately, its content validity will be adversely affected due to inadequate sampling of items.
- (X) **Inadequate Weightage** :Inadequate weightage to some dimensions, sub-topics or objectives would call into question the validity of tool.
- (XI) **Halo Effect** :If a respondent has formed a poor impression about one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue poor on all other aspects too. Similarly, good impression

About one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue high on all other aspects too. This is known as the halo- effect which lowers the validity of the tool about one aspect of the concept, item, person, issue being measured, he/she is likely to rate that concept, item, person, issue poor on all other aspects too.

5A.5 RELIABILITY:

A test score is called reliable when we have reasons of believing the score to be stable and trustworthy. If we measure a student s level of achievement, we hope that his score would be similar under different administrators, using different scores, with similar but not identical items,

or during a different time of the day. The reliability of a test may be defined as-

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

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

A psychological or educational measurement is indirect and is connected with less precise instruments or traits that are not always stable. There are many reasons why a pupil's test score may vary—

- a) Trait Instability :** The characteristics we measure may change over a period of time.
- b) Administrative Error:** Any change in direction, timing or amount of rapport with the test administrative may cause score variability.
- c) Scoring Error:** Inaccuracies in scoring a test paper will affect the scores.
- d) Sampling Error :** Any particular questions we ask in order to infer a person's knowledge may affect his score.
- e) Other Factors :** Such as health, motivation, degree of fatigue of the pupil, good or bad luck in guessing may cause score variability.

5A.6 THE METHODS OF ESTIMATING RELIABILITY:

The four procedures in common use for computing the reliability coefficient of a test

- a) Test – Retest Method
- b) The Alternate or Parallel Forms Method.
- c) The Internal Consistency Reliability
- d) The Inter-rater Reliability

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

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

b) Alternate or Parallel forms Method (Co-efficient of Equivalence Reliability) : When alternative or parallel forms of a test can be developed, the correlation between Form-‘A’ and Form ‘B’ may be taken as a reliability index.

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

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

d) The method of ‘Rational Equivalence (Co-efficient of Internal Consistency) : The method of rational equivalence stresses the inter correlations of items in the test and the correlations of the items with the test as a whole. The assumption is that all items have the same or equal difficulty value, but not necessary the same persons solve each item correctly.

5A.7 FACTORS AFFECTING RELIABILITY:

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

(ii) Test Length :Adding equivalent items makes a test more reliable, while deleting them makes it less reliable.

A longer test will provide a more adequate sample of the behaviour being measured and the scores are apt to be less influenced by chance factors.

Lengthening of a test by a number of practical considerations like time, fatigue, boredom, limited stock of good items.

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

try all the items but, because of the difficulty level, no one obtains a perfect score.

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

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

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

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

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

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

5A.8 ITEM ANALYSIS:

Item analysis begins after the test is over. The responses of the examinees are to be analysed to check the effectiveness of the test items. The teacher must come to some judgments regarding the difficulty level, discriminating power and content validity of items. Only those items which are effective are to be retained, while those which are not should either be discarded or improved. This is known as the process of item-analysis.

A test should be neither too easy nor too difficult; and each item should discriminate validity among the high and low achieving students.

- (i) The difficulty value of each item.
- (ii) The discriminating power of each item.
- (iii) The effectiveness of distracters in the given item.

5A.9 STEPS INVOLVED IN ITEM – ANALYSIS:

- (i) Arrange the **response** sheets from the highest score the lowest score.
- (ii) From the ordered set of **response sheets**, make two groups. Put those

with the highest scores in one group (top 27%) and those with the lowest scores (lowest 27%) in the order group. The responses of the **respondents** in the middle 46% of the group are not included in the analysis.

- (iii) For each item (T/F, completion types) count the number of **respondents** in each group who answered the item correctly. For alternate response type of items, count the number of students in each group who choose each alternate.

A] Estimating Item Difficulty:

The difficulty of a test is indicated by the percentage of pupils who get the item right

$$\text{Difficulty} = \frac{R}{N} \times 100$$

R – number of pupils who answered the item correctly N – total number of pupils who attempted the item.

	Item 1	Item 2	Item 3	Item 4	Item 5
D. index	0.375	0.75	0.50	0.15	0.60

The higher the difficulty index, the easier the item. If an item is too difficult, it cannot discriminate at all and adds nothing to test reliability or validity. An item having 0% or 100% difficulty index has no discriminating value. Half of the items may have difficulty indices between 25% and 75%. One-fourth of the items should have a difficulty index greater than 0.75 and one-fourth of the items should have a difficulty index less than 0.25

B] Estimating Discrimination Index:

The discriminating power of a **tool** item refers to the degree to which it discriminates between the bright and the dull pupils in a group.

An estimate of an **item's** discriminating power can be obtained by the formula:

$$\text{Discriminating power} = \frac{R_u - R_L}{N}$$

R_u – Number of correct responses from upper group. R_L – Number of correct responses from lower group. N – Total number of pupils who attempted the item.

If all the **respondents** from the upper and lower group answer an item correctly or if all fail to answer it correctly, the item has no validity, since in neither case does the item separate the good from the poor **respondents in the sample**.

The item has a **high discrimination power** if **the number of high scorers is greater in the upper group as compared to the number of high scorers in the lower group**.

Items have **zero or negative validity need to be discarded**.

The higher the discrimination index, the better the item.

Thus the results of item-analysis help one judge the worth or quality of a **tool** and also help in revising the **tool** items.

5A.10 STANDARDIZATION OF A TOOL:

A **tool is said to be standardized** if it is constructed according to some 1) well defined procedure; 2) administered according to definite instructions; 3) scored according to a define plan and 4) that it provides a statement of norms.

A **tool** is standardized in respect of content; method of administration; method of scoring; and setting up of norms.

Thus standardization is a process for refining a measuring instrument through scientific procedures.

Its steps are as follows :

- 1. Preparing a draft form of the tool and writing items as per the operational definition of the tool.** Items should be selected in such a way that the expected **respondent** behaviour in different situations is reflected in the items.
- 2. Computing discrimination index and difficulty index (if it is a test) of the items. In other words, conducting item analysis. Through this process, item validity is established.**
- 3. Ascertaining content validity, face validity, construct validity and criterion validity as the case maybe.**
- 4. Ascertaining the reliability of the tool.**
- 5. Fixing the time limit. This includes recording** the time taken by different individuals at the time of the preliminary try out **so as to fix** the time limit for the final **administration of the tool**. It also depends upon the purpose of the **tool**. Time allowances must always take into consideration the age and ability of the **respondents**, the type of items used and the complexity of the learning outcomes to be measured.
- 6. Writing the directions for administering the tool.** Careful instructions for **responding to** different type of **items** and for

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

7. **Preparing a scoring key.** To ensure objectivity in scoring, the scoring should be done **in** a pre-determined **manner**. **In quantitative research**, scoring key is prepared in advance.
8. **Establishing norms. Computing the norms (age-wise, gender-wise, grade-wise, urban-rural location-wise and so on).** Norms provide the user of a standardized **tool** with the basis for a practical interpretation and application of the results. A **respondent's** score can be interpreted only by comparing it with the scores obtained by **similar respondents**. In the process of standardization, the **tool** must be administered to a large, representative sample for whom it is designed.
9. **Preparing manual of the tool.** Every **standardized tool** should be accompanied by the **tool** manual. The purpose of the manual is to explain what the **tool** is supposed to measure, how it was constructed, how it should be administered and scored and how the results should be interpreted and used. **It should also** explain the nature of the sample selected, the number of cases in the sample and the procedure of obtaining the norms. The manual should display the weaknesses as well as the strengths of the **tool** and should provide examples of ways in which the **tool** can be used **as well as** warnings concerning limitations and possible misuse of the results.

Suggested Readings

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TOOLS AND TECHNIQUES OF RESEARCH-II

(TYPES OF TOOLS)

Unit Structure:

- 5B.0 Objectives
- 5B.1 Introduction
- 5B.2 Rating scale
- 5B.3 Attitude scale
- 5B.4 Opinionnaire
- 5B.5 Questionnaire
- 5B.6 Checklist
- 5B.7 Semantic Differentiate scale
- 5B.8 Psychological Test
- 5B.9 Inventory
- 5B.10 Observation
- 5B.11 Interview
- 5B.12 Let us sum up

5B.0 OBJECTIVES:

After reading this unit you will be able to :

- State different types of tools and techniques used for data collection
- Distinguish the basic difference between tools and techniques.
- Describe concept, purpose and uses of various tools and techniques in research.
- State the tools coming under enquiry form, psychological test observation and Interview.

5B.1 INTRODUCTION:

In the last chapter, you have studied about how to prepare a research tool. In this chapter we will study what are those research tools, their concepts and uses in collection of data.

In every research work, it is essential to collect factual material or data unknown or untapped so far. They can be obtained from many sources,

direct or indirect. It is necessary to adopt a systematic procedure to collect essential data. Relevant data, adequate in quantity and quality should be collected. They should be sufficient, reliable and valid.

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

The selection of suitable instruments or tools is of vital importance for successful research. Different tools are suitable for collecting various kinds of information for various purposes. The research worker may use one or more of the tools in combination for his purpose. Research students should therefore familiarize themselves with the verities of tools with their nature, merits and limitations. They should also know how to construct and use them effectively. The systematic way and procedure by which a complex or scientific task is accomplished is known as the technique.

Techniques is the practical method, skill or art applied to a particulate task. So, as a researcher we should aware of both the tools and techniques of research.

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

A. Inquiry forms Questionnaire Checklist Score-card Schedule Rating Scale Opinionnaire Attitude Scale

B. Observation

C. Interview

D. Sociometry

E. Psychological Tests Achievement Test Aptitude Test Intelligence Test Interest inventory

Personality measures etc.

In this unit we will discuss some of the tools of each categories.

5B.2 RATING SCALE:

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

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

Excellent Very good Good Average Below average Poor Very poor



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

Ratings can be obtained through one of three major approaches:

- Paired comparison
- Ranking and
- Rating scales

The first attempt at rating personality characteristics was the man to man technique devised during World-war-I. This technique calls for a panel of raters to rate every individual in comparison to a standard person. This is known as the paired comparison approach.

In the ranking approach every single individual in a group is compared with every other individual and to arrange the judgment in the form of a scale.

In the rating scale approach which is the more common and practical method rating is based on the rating scales, a procedure which consists of assigning to each trait being rated a scale value giving a valid estimate of its status and then comparing the separate ratings into an over all score.

Purpose of Rating Scale:

Rating scales have been successfully utilized for **measuring** the following:

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

Useful hints on Construction of Rating Scale:

A rating scale includes three factors like:

- i) The subjects or the phenomena to be rated.
- ii) The continuum along which they will be rated and
- iii) The judges who will do the rating.

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

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

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

- i) An instruction which names the subject and defines the continuum and
- ii) A scale which defines the points to be used in rating.

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

Use of Rating Scale :

Rating scales are used for testing the validity of many objective instruments like paper pencil inventories of personality. They are also advantages in the following fields like :

- Helpful in writing reports to parents
- Helpful in filling out admission blanks for colleges
- Helpful in finding out student needs
- Making recommendations to employers.
- Supplementing other sources of understanding about the child
- Stimulating effect upon the individuals who are rated.

Limitations of Rating Scale :

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

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

The Errors of Central Tendency :

Some observers want to keep them in safe position. Therefore, they rate near the midpoint of the scale. They rate almost all as average.

Stringency Error :

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

The Halo Error :

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

The Logical Error :

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

Check Your Progress - I

- Q.1 What is rating scale?
- Q.2 What are the approaches of rating?
- Q.3 Explain the various purposes of rating scale?
- Q.4 What are the factors to be considered during construction of rating scale?
- Q.5 What is rating scale? Explain its uses.

Q.6 Write short note son:

- i) The Generosity Error
- ii) The Logical Error
- iii) The Halo error
- iv) Stringency error
- v) The errors of central Tendency

5B.3 ATTITUDE SCALE :

Attitude scale is a form of appraisal procedure and it is also one of the enquiry term. Attitude scales have been designed to measure attitude of a subject of group of subjects towards issues, institutions and group of peoples.

The term attitude is defined in various ways, —the behaviour which we define as attitudinal or attitude is a certain observable set of organism or relative tendency preparatory to and indicative of more complete adjustment.

- L. L. Bernard

—An attitude may be defined as a learned emotional response set for or against something.

-Barr David Johnson

An attitude is spoken of as a tendency of an individual to react in a certain way towards a Phenomenon. It is what a person feels or believes in. It is the inner feeling of an individual. It may be positive, negative or neutral.

Opinion and attitude are used sometimes in a synonymous manner but there is a difference between two. You will be able to know when we will discuss about opinionnaire. An opinion may not lead to any kind of activity in a particular direction. But an attitude compels one to act either favourably or unfavourably according to what they perceive to be correct. We can evaluate attitude through questionnaire. But it is ill adapted for scaling accurately the intensity of an attitude. Therefore, Attitude scale is essential as it attempts to minimise the difficulty of opinionnaire and questionnaire by defining the attitude in terms of a single attitude object. All items, therefore, may be constructed with graduations of favour or disfavour.

Purpose of Attitude Scale :

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

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

Characteristics of Attitude Scale :

Attitude scale should have the following characteristics.

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

Examples of Some Attitude Scale :

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

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

Thurstone Technique :

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

which 50% of the judges placed the item. It will be the median of the frequency distribution in which the score ranges from 0 to 11.

The respondent is to give his reaction to each statement by endorsing or rejecting it. The median values of the statements that he checks establishes his score, or quantifies his opinion. He wins a score as an average of the sum of the values of the statements he endorses.

Thurstone technique is also known as the technique equal appearing intervals.

Sample Items From Thurstone Type Scales :

Statement	Scaled value
I think this company treats its employees	10.4
Better than any other company does.	9.5
It I had to do it over again I'd still work for this company.	5.1
The workers put as much over on the company as the company puts over on them.	2.1
You have got to have pull with certain people around	0.8
here to get ahead. An honest man fails in this company.	

The Likert Scale :

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

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

The Likert's scaling technique assigns a scale value to each of the five responses. All favourable statements are scored from maximum to minimum i. e. from a score of 5 to a score of one or 5 for strongly agree and so on 1 for strongly disagree. The negative statement or statement

opposing the proposition would be scored in the opposite order .e. from a score of 1 to a score of 5 or 1 for strongly agree and so on 5 for strongly disagree.

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

$30 \times 5 =$ Most favorable response possible

$30 \times 3 = 90$ A neutral attitude

$30 \times 1 = 30$ Most unfavorable attitude

It is thus known as a method of summated ratings. The summed up score of any individual would fall between 30 and 150. Scores above 90 will indicate a favourable and scores below 90 an unfavourable attitude.

Sample Items from Linkert Type Minnesota Scale on Morale

Responses	Items
SA A U DSD	Times are getting better
SA A U DSD	Any man with ability and willingness to work hard has a good chance of being successful.
SA A U DSD	Life is just a series of disappointments.
SA A U DSD	It is great to be living in those exciting times.
SA A U DSD	Success is more dependent on luck than on real ability.

Limitations Of Attitude Scale :

In the attitude scale the following limitations may occur:

- An individual may express socially acceptable opinion conceal his real attitude.
- An individual may not be a good judge of himself and may not be clearly aware of his real attitude.
- He may not have been controlled with a real situation to discover what his real attitude towards a specific phenomenon was.
- There is no basis for believing that the five positions indicated in the Likert's scale are equally spaced.
- It is unlikely that the statements are of equal value in 'forness' or againstness.

- It is doubtful whether equal scores obtained by several individuals would indicate equal favourableness towards again position.
- It is unlikely that a respondent can validity react to a short statement on a printed form in the absence of real like qualifying Situation.
- In spite of anonymity of response, Individuals tend to respond according to what they should feel rather than what they really feel.

However, until more precise measures are developed, attitude scale remains the best device for the purpose of measuring attitudes and beliefs in social research.

Check Your Progress – II

Q.1 What is attitude scale? Explain it's purpose and Characteristics.

Q.2 What is attitude scale? Explain the methods of measuring attitudes in research.

Q.3 Define attitude. Explain Likerts scale to measure attitude.

5B.4 OPINIONNAIRE:

Opinion polling or opinion gauging represents a single question approach. The answers are usually in the form of 'yes' or 'no'. An undecided category is often included. Sometimes large number of response alternatives if provided.

- Anna Anastusi

The terms opinion and attitude are not synonymous, though sometimes we used it synonymously. We have till now discussed that attitude scale. We have also discussed that attitudes are impressed opinions. You can now understand the difference between opinionnaire and attitude scale, when we discuss of out opinionnaire, it is characteristics and purposes.

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

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

Purpose :

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

Characteristics :

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

Sample Items of Opinionnaire :

The following statements are from the opinionnaire on the reforms in educational administration introduced in A. P. during 1956-66.

- | | | | |
|---|---|---|---|
| 1) Democratic decentralization has helped to develop democratic values and practices in rural people. | A | U | D |
| 2) There has been consequent improvements of educational standards. | A | U | D |
| 3) Specified subject inspectorate is better than Panel type of inspectorate. | A | U | D |
| 4) Inspection stripped of Administrative powers does not help much. | A | U | D |
| 5) Primary education should be brought under a separate directorate as was done in some status. | A | U | D |

5B.5 QUESTIONNAIRE:

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

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

Purpose :

The purpose of the questionnaire is to gather information from widely scattered sources. It is mostly used in cases where one can not readily see personally all of the people from whom he desires responses. It is also used where there is no particular reason to see them personally.

Types :

Questionnaire can be of various type on the basis of its preparation. They are like:

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

Structured v/s Non-Structured Questionnaire :

The structured questionnaire contains definite, concrete and directed questions, whereas non-structured questionnaire is often used in interview and guide. It may consist of partially completed questions.

Closed v/s Open Questionnaire :

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

Fact and Opinion:

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

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

Planning the Use of Questionnaire :

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

Characteristics of A Good Questionnaire :

Questionnaire should deal with important or significant topic to create interest among respondents.

It should seek only that data which can not be obtained from other sources.

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

When is it appropriate to use a questionnaire for research?

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

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

Designs of Questionnaire :

After construction of questions on the basis of it's characteristics it should be designed with some essential routines like:

- Background information about the questionnaire

- . Instructions to the respondent.
- The allocation of serial numbers and
- Coding Boxes.

Background Information about The Questionnaire

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

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

Instructions to the Respondent :

It is very important that respondents are instructed to go presented at the start of the questionnaire which indicate what is expected from the respondents. Specific instructions should be given for each question where the style of questions varies through out the questionnaire. For Example – Put a tick mark in the appropriate box and circle the relevant number etc.

The Allocation of Serial Numbers :

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

Advantages of Questionnaire :

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

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

Disadvantages :

- It is **reliable** and **valid**, **but** slow.
- Pre-coding questions can deter them from answering.
- Pre-coded questions can bias the findings towards there searcher.
- Postal questionnaire offer little opportunities to check the truthfulness of the answers.
- It can not be used with illiterate and small children.

Irrespective of the limitations general consensus goes in favour of the use of questionnaire. It's quality should be improved and we should be restricted to the situations for which it is suited.

Check Your Progress – III

Q.1 Distinguish between **opinionnaire** and **questionnaire**.

Q.2 Write short notes on:

- (a) Closed and open questionnaire.
- (b) Structured and Non-Structure questionnaire.
- (c) Fact and Opinion.

The serial number helps to distinguish and locate if necessary. It can also helps to identify the date of distribution, the place and possibility the person.

Coding Boxes :

When designing the questionnaire , it is necessary to prevent later complications which might arise at the coding stage. Therefore, you should note the following points:

- Locate coding boxes neatly on the right hand side of the page.
- Allow one coding box for each answer.
- Identify each column in the complete data file underneath the appropriate coding box in the questionnaire.

Besides these, the researcher should also be very careful about the length and appearance of the questionnaire, wording of the questions, order and types of questions while constructing a questionnaire.

Criteria of Evaluating a Questionnaire :

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

- It should provide full information pertaining to the area of research.
- It should provide accurate information.
- It should have a decent response rate.
- It should adopt an ethical stance and
- It should be feasible.

Like all the tools, it also has some advantages and disadvantages based on its uses.

5B. 6 CHECKLIST :

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

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

Purpose :

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

Uses :

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

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

- To know the interest of the subjects also. Kuder's interest inventory and Strong's Interest Blank are also checklists.

Hints on Constructing Checklist :

- Items in the checklist may be continuous or divided into groups of related items.
 - Items should be arranged in categories and the categories in a logical or psychological order.
 - Terms used in the items should be clearly defined.
 - Checklist should be continuous and comprehensive in nature.
 - A pilot study should be taken to make it standardized.
 - Checklist can be constructed in four different ways by arranging items differently.
- (1) In one of the arrangement all items found in a situation are to be checked. For Example, a subject may be asked to check () in the blank side of each activity undertaken in a school.
 - (2) In the second form, the respondent is asked to check with a '__yes' or '__no' or asked to encircle or underline the response to the given item. For Example, (1) Does your school have a house system?
Yes/No
 - (3) In this form, all the items are positive statements with checks () to be marked in a column of a right. For Example, (1) The school functions as a community centre ().
 - (4) The periodical tests are held – fortnightly, monthly, quarterly, regularly.

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

Analysis and Interpretation of Checklist Data :

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

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

Merits :

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

Limitations :

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

For Example, you want to test the story telling skill of a student. You can check only whether the student developed or not developed the skill but you can not study how much he has developed?

When we want to check 'yes' or 'no' of any ability, checklist is used.

Check Your Progress - IV

Q.1 Prepare a checklist for any skill.

5B.7 SEMANTIC DIFFERENTIAL SCALE:

Semantic differential is a type of a rating scale designed to measure the connotative meaning of objects, events and concepts. The connotations are used to drive the attitude towards the given object, event or concept.

Semantic Differential:

sweet

falt warm beautiful meaningful

brave bright

bitter unfalt cold ugly

meaningless cowardly dark

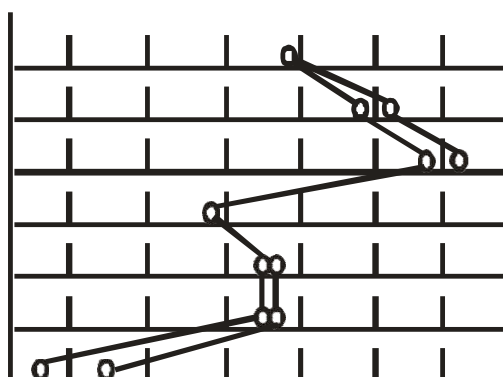


Fig. 1 Modern Japanese version of the semantic Differential.

The Kanji characters in background stand for —God and Wind respectively, with the compound reading Kamikaze. (Adapted from Dimensions of Meaning. Visual Statistics Illustrated at Visual Statistics.net.)

Osgood's semantic differential was designed to measure the connotative meaning of concepts. The respondent is asked to choose where his or her position lies, on a scale between two bipolar adjectives (for example: Adequate-Inadequate, Good-Evil or Valuable-Worthless). Semantic differentials can be used to describe not only persons, but also the connotative meaning of abstract concepts - a capacity used extensively in effect control theory.

Theoretical Background

Nominalists and Realists :

Theoretical underpinnings of Charles E. Osgood's semantic differential have roots in the medieval controversy between then nominalists and realists. Nominalists asserted that only real things are entities and that abstractions from these entities, called universals, are mere words. The realists held that universals have an independent objective existence either in a realm of their own or in the mind of God. Osgood's theoretical work also bears affinity to linguistics and general semantics and relates to Korzybski's structural differential.

Use of Adjectives :

The development of this instrument provides an interesting insight into the border area between linguistics and psychology. People have been describing each other since they developed the ability to speak. Most adjectives can also be used as personality descriptors. The occurrence of thousands of adjectives in English is an attestation of the subtleties in descriptions of persons and their behaviour available to speakers of English. Roget's Thesaurus is an early attempt to classify most adjectives into categories and was used within this context to reduce the number of adjectives to manageable subsets, suitable for factor analysis.

Evaluation, Potency and Activity :

Osgood and his colleagues performed a factor analysis of large collections of semantic differential scales and found three recurring attitudes that people use to evaluate words and phrases: valuation, potency, and activity. Evaluation loads highest on the adjective pair 'active-passive' defines the activity factor. These three dimensions of affective meaning were found to be cross-cultural universals in a study of dozens of cultures.

This factorial structure makes intuitive sense. When our ancestors encountered a person, the initial perception had to be whether that person represents a danger. Is the person good or bad? Next, is the person strong or weak? Our reactions to a person markedly differ if perceived as good and strong, good and weak, bad and weak, or bad and strong.

Subsequently, we might extend our initial classification to include cases of persons who actively threaten us or represent only a potential, danger, and so on. The evaluation, potency and activity factors thus encompass a detailed descriptive system of personality. Osgood's semantic differential measures these three factors. It contains sets of adjective pairs such as warm- cold, bright-dark, beautiful-ugly, sweet-bitter, fair-unfair, brave-cowardly, meaningful-meaningless.

The studies of Osgood and his colleagues revealed that the evaluate factor accounted for most of the variance in scalings, and related this to the idea of attitudes.

Usage :

The semantic differential is today one of the most widely used scales used in the measurement of attitudes. One of the reasons is the versatility of the items. The bipolar adjective pairs can be used for a wide variety of subjects, and as such the scale is nicknamed—the ever ready battery of the attitude researcher.

A. Semantic Differential Scale :

This is a seven point scale and the end points of the scale are associated with bipolar labels.

1						7
Unpleasant Submissive	2	3	4	5	6	Pleasant Dominant

Suppose we want to know personality of a particular person.

We have options –

- Unpleasant /Submissive
- Pleasant /Dominant

Bi-polar means two opposite streams. Individual can score between 1 to 7 or 3 to 3. On the basis of these responses profiles are made. We can analyse for two for three products and by joining these profiles we get profile analysis. It could take any shape depending on the number of variables.

Profile Analysis

...../.....
/
/.....

Mean and median are used for comparison. This scale helps to determine overall similarities and differences among objects.

When Semantic Differential Scale is used to develop an image profile, it provides a good basis for comparing images of two or more items. The big advantage of this scale is its simplicity, while producing results compared with those of the more complex scaling methods. The method is easy and fast to administer, but it is also sensitive to small differences in attitude, highly versatile, reliable and generally valid.

Statistical Properties :

Five items, or 5 bipolar pairs of adjectives, have been proven to yield reliable findings, which highly correlate with alternative measures of the same attitude.

The biggest problem with his scale is that the properties of the level of measurement are unknown. The most statistically sound approach is to treat it as an ordinal scale, but it can be argued that the neutral response (i. e. the middle alternative on the scale) serves as an arbitrary zero point, and that the intervals between the scale values can be treated as equal, making it an interval scale.

A detailed presentation on the development of the semantic differential is provided in the monumental book, Cross-Cultural Universals of Affective Meaning. David R. Heise's Surveying Cultures provides a contemporary update with special attention to measurement issues when using computerized graphic rating scales.

5B.8 PSYCHOLOGICAL TESTS:

Among the most useful and most frequently employed tools of educational research psychological tests occupy a very significant position. Psychological tests are described to describe and measure a sample of certain aspects of human behaviour or inner qualities. They yield objective descriptions of some psychological aspects of an individual's personality and translate them in quantitative terms. As we have mentioned earlier there are various kinds of psychological tests. In this unit we will discuss 'Aptitude tests' and 'Inventories'.

Aptitude Tests :

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

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

Purpose :

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

Importance of Aptitude Test :

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

- They are excellent predictors of future scholastic achievement.
- They provide ways for comparison of a child's performance with other in a same situation.
- They provide a profile of strength and weaknesses. They assess difference among individuals.

Uses Of Aptitude Test :

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

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

Administrative :Result of Aptitude tests help in determining the programmes for college on the basis of aptitude level of high-school.

It can also be identify students to be accelerated or given extra attention, for exampling and in predicting job training performance.

Guidance :result of aptitude tests help counsellors to help parents and students. Parents develop realistic expectations for their Child's performance and students understand their own strength and weaknesses.

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

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

5B. INVENTORY:

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

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

- Internet Inventory and Personality Inventory

Interest Inventory :

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

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

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

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

Check Your Progress –V

- Q.1 What are psychological tests? Explain the use of aptitude test as a tool of research.
- Q.2 What are inventories? Explain its role in research with example.

5B.10 OBSERVATION :

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

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

Purpose :

The purpose of observation techniques are:

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

Characteristics :

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

Observation is systematic.

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

Types of Observation :

On the basis of the purpose of observation may be of varied type like:

- Structured and Unstructured
- Participant and Non-participant

Structured and Unstructured Observation :

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

Participant and Non-Participant Observation:

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

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

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

Non-participant observation is used with groups like infants, children or abnormal persons. It permits the use of recording instruments and the gathering of large quantities of data.

Therefore, some researchers feel that it is best for the observer to remain only a partial participant and to maintain his status of scientific observer apart from the group.

Steps of Effective Observation:

- As a research tool effective observation needs effective Planning
- Execution
- Recording and
- Interpretation **Planning:**

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

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

Execution :

- A good observation plan lends to success only when followed with skill and expert execution. Expert execution needs:
- Proper arrangement of special conditions for the subject.
- Assuming the proper physical position for observing.
- Focusing attention on the specific activities or units of behaviour under observation.
- Observing discreetly the length and number of periods and internals decided upon.
- Handling well the recording instruments to be used. Utilising the training received in terms of expertness.

Recording:

The two common procedures for recording observations are:

- Simultaneous
- Soon after the observation

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

Interpretation:

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

Limitations of Observation :

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

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

Advantages of Observation :

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

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

Check Your Progress – VI

Q.1 Explain the steps of observational techniques with its merits and limitations.

Q.2 Write short notes on:

(a) Participant and non-participant observation.

(b) Structured and non-structured observation.

5B.11 INTERVIEW :

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

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

Importance of Interview :

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

- Emotions, experiences and feelings.
- Sensitive issues.
- **Privileged** information.
- It is appropriate when dealing with young children, illiterates, language difficulty and limited intelligence.
- It supplies the detail and depth needed to ensure that the questionnaire asks valid questions while preparing questionnaire.
- It is a follow up to a questionnaire and complements the questionnaire.
- It can be combined with other tools in order to corroborate facts using a different approach.
- It is one of the normative survey methods, but it is also applied in historical, experimental, case studies.

Types of Interview :

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

Structured Interview :

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

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

Semi-Structured Interview :

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

Unstructured Interview :

In case of unstructured interview, emphasis is placed on the interviewee's thoughts. The researcher introduces a theme or topic and then letting the interviewee develop his or her ideas and pursue his or her train of thought. Allowing interviewees to speak their minds is a better way of discovering things about complex issues. It gives opportunity for in depth investigations.

Single Interview :

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

Group Interview :

In case of group interview, more than one informant is involved. The numbers involved normally about four to six people. Here you may think that it is difficult to get people together to discuss matters on one occasion and how many voices can contribute to the discussion during any one interview. But the crucial thing to bear in mind. Here is that a group

interview is not an opportunity for the researcher to questions to a sequence of individuals, taking turns around a table. ‘group’ is crucial here, because it tells us that those present in the interview will interact with one another and that the discussion will operate at the level of the group. They can present a wide range of information and varied view points.

According to Lewis –

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

The disadvantages of this type of interview is that the views of ‘quieter’ people does not come out. Certain members may dominate the talk. The most disadvantage is that whatever opinions are expressed are acceptable by the group irrespective of their opinions contrary to it. Private opinion does not given importance.

Focus Group Interview :

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

Requirements of a Good Interview :

As a tool of research good interview requires: Proper preparation.

- Skillful execution and
- Adequate recording and interpretation.

Preparation for Interview :

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

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

Execution of the Interview :

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

Recording and Interpreting Responses :

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

Advantages of Interview :

Interview techniques have the following advantages:

Depth Information :

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

Insights :

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

Equipment:

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

Information Priorities :

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

Flexibility :

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

Validity :

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

High response rate :

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

Therapeutic:

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

Disadvantages of Interviews :

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

Time Consuming :

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

Difficulty in data analysis :

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

Less Reliability :

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

Interviewer Effect :

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

Inhibitions :

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

Invasion of Privacy :

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

Resources:

The cost of interviewer's time, of travel and of transcription can be relatively high if the informants are geographically widespread.

On the basis of the merits and limitations of the interview techniques it is used in many ways for research and non-research purposes. This technique was used in commonwealth teacher training study to know the traits most essentials for success in teaching. Apart from being an independent data collection tool, it may play an important role in the preparation of questionnaires and check lists which are to be put to extensive use.

Check Your Progress - VII

Q.1 Explain different types of interview for the purpose of research.

Q.2 Write short notes on:

- (a) Importance of Interview.
- (b) Requisites of a good interview.

5B.12 LET US SUM UP :

You would recall that we have touched upon the following learning items in this unit.

For the purpose of collecting new relevant data for a research study, the investigator needs to select proper instruments termed as tools and techniques.

The major tools of research can be classified into broad categories of inquiry form, observation, interview, social measures and Psychological tests.

Among the inquiry forms, we have discussed in this unit are Rating scale, attitude scale, opinionnaire, questionnaire checklist and semantic differential scale. Observation and Interview are explained as the techniques of data collection. In psychological tests, Aptitude tests and inventories are discussed.

Rating scale is a technique which is designed or constructed to assess the personality of an individual. It is very popular in testing applied psychology, vocational guidance and counseling as well as in basic research. They measure the degree or amount of the indicated judgments.

Attitude scale is the device by which the feelings or beliefs of persons are described and measured indirectly through securing their responses to a set of favourable statements. Thurstone and Likert scale are commonly adopted for attitude scaling.

Opinionnaire is a special form of inquiry. It is used by the researcher to collect the opinions of a sample of population. It is usually used in descriptive type research.

Questionnaire is a tool which used frequently. The purpose is to gathered information from widely scattered sources. Data collected in written form through thistool.

Checklist is a selected list of words, Phrases, Sentences and paragraphs following which an observer records a check mark to denote a presence or absence of whatever is being observed. It calls for a simple yes / no judgments. The main purpose is to call attention to various aspects of an object or situation, to see that nothing of importance is overlooked.

Semantic Differential Scale is a seven point scale and the end points of the scale are associated with bipolar labels. This scale helps o determine overall similarities and differences among objects.

Aptitude tests are psychological tests attempt to product the capacities or the degree of achievement expected from individuals in a particular activity. The purpose is to test a candidate's profile.

Inventory is a list, or record containing traits, preferences, attitudes interests or abilities used to evaluate personal characteristics or skills. Strong's vocational interest inventory is an example of interest inventory.

Observation method is a technical in which the behaviour research subjects is watched and recorded without any direct contact. It deals with the overt behaviour of persons in controlled or uncontrolled situations.

Interview is an oral type of questionnaire where the subject supplies the needed information in a face to face situation. It is specially appropriate for dealing with young children, illiterates, dull and the abnormal.

Unit End Exercises:

1. State the characteristics of a questionnaire.
2. What are the disadvantages of an Interview?
3. Prepare items using Rating scale, Interview and Questionnaire for a research proposal.

Reference Books :

- Siddhu Kulbir Singh (1992). Methodology of Research in Education, Sterling Publisher, NewDelhi.
- Sukhia S. P. and Mehrotra P. V. (1983). —Elements of educational Research Allied Publisher Private Limited New Delhi
- Denscombe, Martyn(1999).—The Good Research Guide Viva Books Private Limited, New Delhi.



DATA ANALYSIS AND REPORT WRITING - I (QUANTITATIVE DATA ANALYSIS)

Unit Structure :

6A.0 Objectives

6A.1 Introduction

6A.2 Types of Measurement Scale

6A.3 Quantitative Data Analysis

6A.3.1 Parametric Techniques

6A.3.2 Non- Parametric Techniques

6A.3.3 Conditions to be satisfied for using parametric techniques

6A.3.4 Descriptive data analysis (Measures of central tendency, variability, fiduciary limits and graphical presentation of data)

6A.3.5 Inferential data analysis

6A.3.6 Use of Excel in Data Analysis

6A.3.7 Concepts, use and interpretation of following statistical techniques: Correlation, t-test, z-test, ANOVA, Critical ratio for comparison of percentages and chi-square (Equal Probability and Normal Probability Hypothesis).

6A.4 Testing of Hypothesis

6A.5 Interpretation of Result

6A.0 OBJECTIVES:

After reading this unit the student will be able to :

- Explain different types of measurement scales with appropriate examples.
- State the Conditions to be satisfied for using parametric techniques
- List the examples of parametric and non-parametric techniques.
- State the statistical measures of descriptive and inferential data analysis.
- Explain concepts of different statistical techniques of data analysis and their interpretation.

6A.1 INTRODUCTION:

Statistical data analysis depends on several factors such as the type of measurement scale used, the sample size, sampling technique used and the shape of the distribution of the data. These will be described in this unit.

6A.2 SCALES OF MEASUREMENT:

The level of measurement refers to the relationship among the values that are assigned to the attributes for a variable. It is important to understand the level of measurement as it helps you to decide how to interpret the data from the variable concerned. Second, knowing the level of measurement helps you to decide which statistical techniques of data analysis are appropriate for the numerical values that were assigned to the variables.

Types of Scales of Measurement

There are typically four scales or levels of measurement that are defined :

- a. Nominal
- b. Ordinal
- c. Interval
- d. Ratio

a. Nominal Scale : It is the lowest level of measurement. A nominal scale is simply some placing of data into categories, without any order or structure. A simple example of a nominal scale is the terms we use. For example, religion as the names of religion are categories where no ordering is implied.. Other examples are gender, medium of instruction, school types and so on. In research activities, a YES/NO scale is also an example of nominal scale. In nominal measurement the numerical values just "name" the attribute uniquely. The statistical techniques of data analysis which can be used with nominal scales are usually non-parametric.

b. Ordinal Scale : An ordinal scale is next up the list in terms of power of measurement. In ordinal measurement, the attributes can be rank-ordered. Here, distances between attributes do not have any meaning. For example, on a survey you might code Educational Attainment as 0=less than High School; 1=some High School; 2=High School; 3=Junior College; 4=College degree; 5=post-graduate degree. In this measure, higher numbers mean more education. But is distance from 0 to 1 same as 3 to 4? Of course not. The simplest ordinal scale is a ranking. There is no objective distance between any two points on your subjective scale. An ordinal scale only lets you interpret gross order and not the relative positional distances. The statistical techniques of data analysis which can be used with nominal scales are usually non- parametric statistics. These would include Karl-Pearson's coefficient of correlation and non-parametric analysis of variance.

c. Interval Scale : In interval measurement, the distance between attributes does have meaning. For example, when we measure temperature (in Fahrenheit), the distance between 30 and 40 is same as distance between 70 and 80. The interval between values is interpretable. Because of this, it makes sense to compute an average of an interval variable, whereas it does not make sense to do so for ordinal scales. The rating scale is an interval scale. i.e. when you are asked to rate your job satisfaction on a 5 point scale, from strongly dissatisfied to strongly satisfied, you are using an interval scale. This means that we can interpret differences in the distance along the scale. There is no absolute zero in the interval scale. For example, if a student gets a score of zero on an achievement test, it does not imply that his knowledge/ability in the subject concerned is zero as on another, similar test in the same subject consisting of another set of questions, the student could have got a higher score. Thus a score of zero does not imply a complete lack of the trait being measured in the subject. When variables are measured in the interval scale, parametric statistical techniques of data analysis can be used. However, non-parametric techniques can also be used with interval and ratio data.

d. Ratio Scale : Finally, in ratio scale, there is always an absolute zero that is meaningful. This means that you can construct a meaningful fraction (or ratio) with a ratio variable. Weight is a ratio variable. In educational research, most "count" variables are ratio, for example, the number of students in a classroom. This is because you can have zero students and because it is meaningful to say that "...we had twice as many students in a classroom as compared to another classroom." A ratio scale is the top level of measurement. When variables are measured in the ratio scale, parametric statistical techniques of data analysis can be used.

It is important to recognize that there is a hierarchy implied in the level of measurement idea. In general, it is desirable to have a higher level of measurement (e.g., interval or ratio) rather than a lower one (nominal or ordinal).

Check Your Progress - I

Q.1 State the different types of measurement scale.

Q.2 Give three examples where you can use the following scales of measurement :

- (a) Nominal Scale
- (b) Ordinal Scale
- (c) Interval Scale
- (d) Ratio Scale

6A.3 QUANTITATIVE DATA ANALYSIS

6A.3.1 Parametric Techniques

Parametric statistics based in the assumption about the distribution of population from which the sample is taken.

The information about the distribution of population is known and it is based on certain fixed parameters. It assumes normal distribution of the attributes being studied. When the data deviates strongly from the assumptions, using parametric procedures could lead to incorrect conclusions.

The commonly used parametric techniques are t-test, ANOVA, Pearson coefficient of correlation.

6A.3.2 Non-Parametric Techniques

Non-parametric statistics is based on no or few assumptions about population. It means that the data can be collected from a sample that does not follow any specific distribution.

The information about the distribution of population is unknown. The parameters of distribution of population are not fixed. Hence it is necessary to test the hypothesis for the population under consideration.

Interpretation of non-parametric procedures is more difficult as compared to parametric procedures.

The example of non-parametric technique is Spearman's rank correlation

6A.3.3 Conditions to be satisfied for Using Parametric Techniques:

These are as follows :

1. The sample size is greater than 30.
2. Data are normally distributed.
3. Data are measured in interval or ratio scales.
4. Variances of different sub-groups are equal or nearly equal.
5. The sample is selected randomly.
6. Observations are independent.

6A.3.4 Descriptive Data Analysis

Descriptive statistics are used to present quantitative descriptions in a manageable form. In a research study, we may have lots of measures. Or we may measure a large number of people on one measure. Descriptive statistics help us to simplify large amounts of data in a sensible way. Each descriptive statistic reduces lots of data into a simpler summary. For instance, consider a simple number used to summarize how well a batter is performing in baseball, the batting average. This single number is simply the number of hits divided by the number of times at bat (reported to three

significant digits). A batter who is hitting .333 is getting a hit one time in every three at bats. One batting .250 is hitting one time in four. The single number describes a large number of discrete events. For example, we may describe the performance of students of a class in terms of their average performance. Descriptive statistics provide a powerful summary that may enable comparisons across people or other units.

Measures of Central Tendency : These include Mean, Median and Mode which indicate the average value of the variable being studied (Mean), the value above and below which lie 50% of the sample values (Median) and the value which occurs the maximum number of times in the sample (Mode). These help in determining the extent of normality of the distribution of scores on the variable being studied.

Measures of Variability : These include the standard deviation, skewness and kurtosis. The standard deviation indicates the deviation of each score from the Mean. Skewness indicates whether majority of the scores lie to the left of the Mean (positively skewed), to the right of the Mean (negatively skewed) or bell-shaped (normally distributed). Kurtosis indicates whether the distribution of the scores is flat (platykurtic), peaked (leptokurtic) or bell-shaped (mesokurtic).

Fiduciary Limits : These indicate the interval (or the fiduciary limits) within which the Mean of the population will lie at 0.95 or 0.99 levels of confidence. The fiduciary limits or the confidence interval of the population Mean is estimated based on the sample mean. The sample Mean is known as the 'Statistic' and the population mean is known as the 'parameter'. The computation of population Mean requires the use of Standard Error of the Mean. Similarly, fiduciary limits or the confidence interval of the population standard deviation is also computed.

Graphical Presentation of Data : This includes bar diagrams, pie charts and line graph. The line graph is usually used to represent the distribution of the scores obtained on a variable with the objective of indicating the shape of the distribution. The bar diagram is used for making comparisons of Mean scores on the variable being studied in various sub-groups such as boys v/s girls, urban v/s rural, private-aided v/s private-unaided v/s municipal schools, SSC v/s CBSE v/s ICSE v/s IGCSE schools and so on. Pie charts are used to indicate proportion of different sub-groups in the sample or the variance of a specific variable associated with another variable.

Check Your Progress - I

1. Explain the meaning of parametric and non-parametric techniques of data analysis.
2. State the conditions necessary for using parametric techniques of data analysis.
3. Which are the measures of central tendency and variability? Why is it necessary to compute these?

4. You want to (i) compare the Mean Academic Achievement of boys and girls, (ii) show whether the Academic Achievement scores of students are normally distributed or not and (iii) show the proportion of boys and girls in the total sample. State the graphical techniques to be used in each of these cases.

6A.3.5 Inferential Data Analysis

Descriptive data analysis only describes the data and the characteristics of the sample in terms of statistics. Its findings could not be generalised to larger population.

On the other hand, the findings of the inferential analysis can be generalised to larger population.

6A.3.6 Use of Excel in Data Analysis : The MS-Excel is an excellent tool for analysing data using statistical techniques descriptive statistics such as the Mean, Median, Mode, SD, Skewness and Kurtosis and inferential techniques including t-test, ANOVA, correlation. It also helps in presenting data graphically through bar diagrams, line graph and pie-chart.

6A. 3.7 Concepts, Use and Interpretation of Statistical Techniques

A. Correlation: When the variables are in the interval or ratio scale, correlation and regression coefficients are computed. A Pearson product-moment correlation coefficient is a measure of linear association between two variables in interval or ratio scale. The measure, usually symbolised by the letter r , varies from -1 to $+1$, with 0 indicating no linear association. The word correlation is sometimes used in a non-specific way as a synonym for association. Here, however, the Pearson's product-moment correlation coefficient is a measure of linear association computed for a specific set of data on two variables. For example, if a researcher wants to ascertain whether teachers' job satisfaction is related to their school climate, Pearson's product-moment correlation coefficient could be computed for teachers' scores on these two variables.

Interpretation of "r" : This takes into account four major aspects as follows:

- a. Level of significance (usually at 0.01 or 0.05 levels in educational research).
- b. Magnitude of r : In general, the following forms the basis of interpreting the magnitude of their:

No.	Value of "r"	Magnitude
1	0.00-0.20	Negligible
2	0.21-0.40	Low
3	0.41-0.60	Moderate
4	0.61-0.80	Substantial
5	0.81-1.00	Very High

c. Direction of $-r$: The $-r$ could be positive, negative or zero. (i) A positive r signifies that the relationship between two variables is direct i.e. if the value of one variable is high, the other is also expected to be high. For example, if there is a substantial relationship between IQ and Academic Achievement of students, it implies that higher the IQ of students, higher is likely to be their Academic Achievement.

(ii) A negative $-r$ signifies that the relationship between two variables is inverse i.e. if the value of one variable is high, the other is also expected to be low. For example, if there is a substantial relationship between Anxiety and Academic Achievement of students, it implies that higher the Anxiety of students, lower is likely to be their Academic Achievement.

(iii) The relationship between two variables could be zero.

d. The Coefficient of Determination: It refers to the percentage of variability in one variable that is associated with variability in the other variable. It is computed using the formula $100r^2$. The square of the correlation coefficient i.e. $100r^2$ is another PRE (proportionate reduction in error) measure of association.

B. t-test : A t-test is used to compare the Mean Scores obtained by two groups on a single variable. It is also used when F-ratio in ANOVA is found to be significant and the researcher wants to compare the Mean scores of different groups included in the ANOVA. It can also be used to compare the Mean Academic Achievement of two groups such as (i) boys and girls or (ii) Experimental and Control groups etc. The t-test was introduced in 1908 by William Sealy Gosset, a chemist working in Ireland. His pen name was "Student".

The assumptions on which the t-test is used are as follows:

- (a) Data are normally distributed. This can be ascertained by using normality tests such as the Shapiro-Wilk and Kolmogorov-Smirnov tests.
- (b) Equality of variances which can be tested by using the F-test or the more robust Levene's test, Bartlett's test or the Brown-Forsythe test.
- (c) Samples may be independent or dependent, depending on the hypothesis and the type of samples. For the inexperienced researcher, the most difficult issue is often whether the samples are independent or dependent. Independent samples are usually two randomly selected groups unrelated to each other such as boys and girls or private-aided and private-unaided schools in a causal-comparative research. On the other hand, dependent samples are either two groups matched (or a "paired" sample) on some variable (for example, IQ or SES) or are the same people being tested twice (called repeated measures as is done in an experimental design).

Dependent t-tests can also be used for matched-paired samples, where two groups are matched on a particular variable. For example, if we examined

the IQ of twins, the two groups are matched on genetics. This would call for a dependent t-test because it is a paired sample (one child/twin paired with one another child/twin). However, when we compare 100 boys and 100 girls, with no relationship between any particular boy and any particular girl, we would use an independent samples test. Another example of a matched sample would be to take two groups of students, match each student in one group with a student in the other group based on IQ and then compare their performance on an achievement test. Alternatively, we assign students with low scores and students with high scores in two groups and assess their performance on an achievement test independently. An example of a repeated measures t-test would be if one group were pre-tested and post-tested as is done in educational research quite often especially in experiments. If a teacher wanted to examine the effect of a new set of textbooks on student achievement, he could test the class at the beginning of the treatment (pre-test) and at the end of the treatment (post-test). A dependent t-test would be used, treating the pre-test and post-test as matched variables (matched by student).

Types of t-test :

(a) Independent one-sample t-test : Suppose in a research, on the basis of past research, the researcher finds that the Mean Academic Achievement of students in Mathematics is 50 with a SD of 12. If the researcher wants to know whether this year's students' Academic Achievement in Mathematics is typical, he takes $\mu_0 = 50$ which is the population Mean and $S = 12$ where S is the population SD. Suppose $N = 36$. In testing the null hypothesis that the population mean is equal to a specified value μ_0 , one uses the statistic t the formula for which is follows:

$$t = [M - \mu_0] / \sqrt{S/N}$$

where S is the population standard deviation and N is the sample size. The degrees of freedom used in this test is $N - 1$.

(b) Independent two-sample t-test : This is of the following three types:

(i) Equal sample sizes, equal variance : This test is only used when both the samples are of the same size i.e. $N_1 = N_2 = N$ and when it can be assumed that the two distributions have the same variance. Its formula is as follows:

Standard Error of the Difference between Means (SED)

$$= \sqrt{(\sigma_1^2 + \sigma_2^2) \div N} \quad t = (M_1 - M_2) \div \text{SED}$$

Where,

M_1 = Mean of Group 1 M_2 = Mean of Group 2 σ_1 = SD of Group 1 σ_2 = SD of Group 2

(ii) Unequal sample sizes, equal variance : This test is used only when it can be assumed that the two distributions have the same variance. The t statistic to test whether the means are different can be calculated as follows:

Standard Error of the Difference between Means (SED)

$$= \sqrt{(\sigma_1^2 / N_1 + \sigma_2^2 / N_2)} \quad t = (M_1 - M_2) \div SED$$

Where,

M_1 = Mean of Group 1 M_2 = Mean of Group 2 σ_1 = SD of Group 1 σ_2 = SD of Group 2

(iii) Unequal sample sizes, unequal variance : This test is used only when the two sample sizes are unequal and the variance is assumed to be different. The t statistic to test whether the means are different can be calculated as follows:

Standard Error of the Difference between Means (SED)

$$= \sqrt{(\sigma_1^2 / N_1 + \sigma_2^2 / N_2)} \quad t = (M_1 - M_2) \div SED$$

However, the tabulated t (t_t) against which the obtained t (t_o) is compared in order test its significance is calculated differently using the following formula:

Suppose for Sample 1, for $df = N-1$, tabulated t (t_t) at 0.05 level of significance = x

and

Sample 2, for $df = N-1$, tabulated t (t_t) at 0.05 level of significance = y.

SE_1 = Standard Error of M_1 SE_2 = Standard Error of M_2

Corrected tabulated t (t_t) at 0.05 level of significance

$$= (SE_1^2 \times x) + (SE_2^2 \times y) \div (SE_1^2 + SE_2^2)$$

Where,

M_1 = Mean of Group 1 M_2 = Mean of Group 2 σ_1 = SD of Group 1 σ_2 = SD of Group 2

(c) Dependent t-test for paired samples : This test is used when the samples are dependent; that is, when there is only one sample that has been tested twice (repeated measures) or when there are two samples that have been matched or "paired" as is usually done in experimental research. Its formula is as follows:

Standard Error of the (Mean) $_1 = \sigma_1' / \sqrt{N_1} = SEM_1$ Standard Error of the (Mean) $_2 = \sigma_2' / \sqrt{N_2} = SEM_2$ Standard Error of the Difference between Means (SED)

$$= \sqrt{(SEM_1 + SEM_2 - 2r \cdot SEM_1 SEM_2)} \quad t = (M_1 - M_2) \div SED$$

Where,

M_1 = Mean of Pre-test Scores M_2 = Mean of Post-test Scores σ_1 = SD of Group1

σ_2 = SD of Group2

r = Coefficient of Correlation between Pre-test and Post-test Scores

Alternatives to the t test

The t test can be used to test the equality of the means of two normal populations with unknown, but equal, variance. To relax the normality assumption, a non-parametric alternative to the t test can be used and the usual choices are (a) for independent samples, the Mann-Whitney U test and (b) for related samples, either the binomial test or the Wilcoxin signed-rank test. To test the equality of the means of more than two normal populations, an analysis of variance can be performed.

z-test : It is used to compare two coefficients of correlation. For example, a researcher studies the relationship between job satisfaction and school climate among two groups, viz., male and female teachers. Further, he may want to ascertain whether this relationship differs among male and female teachers. In this case, he will have two coefficients of correlation, r_1 for male teachers and r_2 for male teachers for the variables of job satisfaction and school climate. In such a case, z-test is used the formula for which is as follows:

$$z = (z_1 - z_2) / \sqrt{(1 / N_1 - 3 + 1 / N_2 - 3)}$$

ANOVA : Analysis of variance (ANOVA) is used for comparing more than two groups on a single variable. It a collection of statistical models and their associated procedures, in which the observed variance is partitioned into components due to different explanatory variables. In its simplest form ANOVA gives a statistical test of whether the means of several groups are all equal, and therefore generalizes Student's two-sample t-test to more than two groups.

There are three conceptual classes of such models:

1. Fixed-effects model assumes that the data came from normal populations which may differ only in their means. The fixed-effects model of analysis of variance applies to situations in which the experimenter applies several treatments to the subjects of the experiment to see if the response variable's values change. This allows the experimenter to estimate the ranges of response variable values that the treatment would generate in the population as a whole.

2. Random-effects model assumes that the data describe a hierarchy of different populations whose differences are constrained by the hierarchy. Random effects models are used when the treatments are not fixed. This occurs when the various treatments (also known as factor levels) are sampled from a larger population. Because the treatments themselves are

random variables, some assumptions and the method of contrasting the treatments differ from ANOVA.

3. Mixed-effect model describes situations where both fixed and random effects are present.

Types of ANOVA : These are as follows :

(a) **One-way ANOVA :** It is used to test for differences among two or more independent groups. Typically, however, the one-way ANOVA is used to test for differences among three or more groups, since the two-group case can be covered by student's t-test. When there are only two means to compare, the t-test and the F-test are equivalent with $F = t^2$. For example, a researcher wants to compare students' attitude towards the school on the basis of school types (SSC, CBSE and ICSE). In this case, there is one dependent variable, namely, attitude towards the school and three groups, namely, SSC, CBSE and ICSE schools. Here, the one-way ANOVA is used to test for differences in students' attitude towards the school among the three groups.

(b) **One-way ANOVA for repeated measures :** It is used when the subjects are subjected to repeated measures. This means that the same subjects are used for each treatment. Note that this method can be subject to carryover effects. This technique is often used in experimental research in which we want to compare three or more groups on one dependent variable which is measured twice i.e. as pre-test and post-test.

(c) **Two-way ANOVA :** It is used when the researcher wants to study the effects of two or more independent or treatment variables. It is also known as factorial ANOVA. The most commonly used type of factorial ANOVA is the 2×2 (read as "two by two", as you would a matrix) design, where there are two independent variables and each variable has two levels or distinct values. Two-way ANOVA can also be multi-level such as 3×3 , etc. or higher order such as $2 \times 2 \times 2$, etc. but analyses with higher numbers of factors are rarely done by hand because the calculations are lengthy. However, since the introduction of data analytic software, the utilization of higher order designs and analyses has become quite common. For example, a researcher wants to compare students' attitude towards the school on the basis of (i) school types (SSC, CBSE and ICSE) and (ii) gender. In this case, there is one dependent variable, namely, attitude towards the school and two independent variables, viz., (i) school types including three levels, namely, SSC, CBSE and ICSE schools and (ii) gender including two levels, namely, boys and girls. Here, the two-way ANOVA is used to test for differences in students' attitude towards the school on the basis of (i) school types and (ii) gender. This is an example of 3×2 two-way ANOVA as there are three levels of school types, namely, SSC, CBSE and ICSE schools and two levels of gender, namely, boys and girls. It is known as two-way ANOVA as it involves comparing one dependent variable (attitude towards the school) on the basis of two independent variables, viz., (i) school types and (ii) gender.

(d) **MANOVA:** When one wants to compare two or more independent groups in which the sample is subjected to repeated measures such as pre-test and post-test in an experimental study, one may perform a factorial mixed- design ANOVA i.e. Multivariate Analysis of Variance or MANOVA in which one factor is a between-subjects variable and the

other is within-subjects variable. This is a type of mixed-effect model. It is used when there is more than one dependent variable.

(e) **ANCOVA** :While comparing two groups on a dependent variable, if it is found that they differ on some other variable such as their IQ, SES or pre-test, it is necessary to remove these initial differences. This can be done through using the technique of ANCOVA.

Assumptions of Using ANOVA

1. Independence of cases.
2. Normality of the distributions in each of the groups.
3. Equality or homogeneity of variances, known as homoscedasticity i.e. the variance of data in groups should be the same. Levene's test for homogeneity of variances is typically used to confirm homoscedasticity. The Kolmogorov-Smirnov or the Shapiro-Wilk test may be used to confirm normality. According to Lindman, F-test is unreliable if there are deviations from normality whereas Ferguson and Takane claim that the F- test is robust. The Kruskal-Wallis test is a non-parametric alternative which does not rely on an assumption of normality. These together form the common assumption that the errors are independently, identically, and normally distributed for fixed effects models.

Critical Ratio for Comparison of Percentages : This technique is used when the researcher wants to compare two percentages. Its formula is as follows :

(i) For uncorrelated percents : $CR = P_1 - P_2 \div (SE \text{ of Percentage})$

Where,

P_1 = Percentage occurrence of observed behaviour in Group 1
 P_2 = Percentage occurrence of observed behaviour in Group 2
 $P = (N_1P_1 + N_2P_2) \div (N_1 + N_2)$

P = Percent occurrence of observed behaviour $Q = 1 - P$

$SE \text{ of difference between percentages} = \sqrt{[PQ(1/N_1 + 1/N_2)]}$

(ii) For correlated percents:

$CR = P_1 - P_2 \div (SE \text{ of Percentage})$ Where,

P_1 = Percentage occurrence of observed behaviour in Group 1
 P_2 = Percentage occurrence of observed behaviour in Group 2
 $P = (N_1P_1 + N_2P_2) \div (N_1 + N_2)$

P = Percent occurrence of observed behaviour $Q = 1 - P$

$SE \text{ of difference between percentages}$

$= \sqrt{[(SE)_{P_1} + (SE)_{P_2} - 2r(SE)_{P_1} \times (SE)_{P_2}]}$

The obtained CR is compared with tabulated CR given in statistical table to test its significance.

Chi-square (Equal Probability and Normal Probability Hypothesis):

A chi-square test (also chi-squared or χ^2 test) is any statistical test in which the test statistic has a chi-squared distribution when the null hypothesis is true, or any distribution in which the probability distribution of the test statistic (assuming the null hypothesis is true) can be made to approximate a chi-square distribution as closely as desired by making the sample size large enough. Chi-square is a statistical test commonly used to compare observed data with data we would expect to obtain according to a specific hypothesis. For example, if a researcher expects parents' attitude towards sex education to be provided in schools to be normally distributed, then he might want to know about the "goodness to fit" between the observed and expected results i.e. whether the deviations (differences between observed and expected) the result of chance, or whether they are due to other factors. The chi-square test tests the null hypothesis, which states that there is no significant difference between the expected and observed result. If it is assumed that the expected frequencies are equally distributed in all the cells, the chi-square test is known as equal distribution hypothesis. On the other hand, if it is assumed that the frequencies are expected to be distributed normally, the chi-square test is known as normal distribution hypothesis. The chi-square (χ^2) test measures the alignment between two sets of frequency measures. These must be categorical counts and not percentages *or* ratios measures.

Thus, Chi-squared, $\chi^2 = \sum (f_o - f_e)^2 / f_e$ where,

f_o = observed frequency and f_e = expected frequency.

It may be noted that the expected values may need to be scaled to be comparable to the observed values. A simple test is that the total frequency/count should be the same for observed and expected values. In a table, the expected frequency, if not known, may be estimated as: $f_e = (\text{row total}) \times (\text{column total}) / N$, where N is the total number of all the rows (or columns). The obtained Chi Square is compared with that given in the Chi Square table to determine whether the comparison shows significance.

In a table, the degrees of freedom are computed as follows : $df = (R - 1) \times (C - 1)$,

Where R = number of rows C = number of columns.

Chi-square indicates whether there is a significant association between variables, but it does not indicate just how significant and important this is.

Check Your Progress – II

Suggest appropriate statistical technique of data analysis in the following cases :

- (a) You want to find out the relationship between academic achievement and motivation of students.
- (b) You want to compare the academic achievement of boys and girls:
- (c) You are conducting a survey of teachers' opinion about admission criteria for junior college admissions and want to know whether their opinion is favourable or not.
- (d) You want to compare the academic achievement of students from private-aided, private-unaided and municipal schools.
- (e) You want to compare whether the percentage of girls and boys enrolling for secondary school:

6A.4 TESTING OF HYPOTHESIS :

There are a number of ways in which the testing of the hypothesis may bear on a theory. According to Wallace, it can

- (i) Lend confirmation to the theory by not disconfirming it.
- (ii) Modifying the theory by disconfirming it, but not at a crucial point ;or
- (iii) Overthrow the theory by disconfirming it at a crucial point in its logical structure, or in its competitive value as compared with rival theories.

Methods of Testing of Hypothesis

There are three major methods of testing of hypothesis as follows:

1. **Verification** : The best test of a hypothesis is to verify whether the inferences reached from the propositions are consistent with the observed facts. Verification is of two types as follows: (a) Direct Verification by Observation or Experimentation and (b) Indirect Verification by deducing consequences from the supposed cause and comparing them with the facts of experience. This necessitates the application of the principle of deduction.
2. **Experimentum Crucis** : This is known as crucial instance or confirmatory test. When a researcher is confronted with two equally competent but contradictory hypotheses, he needs one instance which explains the phenomenon and helps in accepting any one of the hypotheses. When this is done through an experiment, the experiment is known as Experimentum Crucis'.
3. **Consilience of Inductions** : This refers to the power which a hypothesis has of _explaining and determining cases of a kind different from those which were contemplated in the formation of hypothesis'. In other words, the hypothesis is accepted and its value is greatly enhanced when it is found to explain other facts also in addition to those facts which it was initially designed to explain.

Errors in Testing of Hypothesis:

A researcher tests the null hypothesis using some statistical technique. Based on the test of statistical significance he / she accepts or rejects the null hypothesis and thereby either rejects or accepts the research hypothesis respectively.

If the null hypothesis is true and is accepted or when it is false and is rejected, the decisions taken are true.

However, error in testing of hypothesis occurs under the following two situations:

(i) If the null hypothesis (H_0) is true but is rejected and

(ii) If the null hypothesis (H_0) is false but is accepted.

The former is the example of Type I error while the latter is the example of Type II error in testing of hypothesis.

Type I error occurs when a true null hypothesis is rejected. It is also known as Alpha (α) error.

Type II error occurs when a false null hypothesis is accepted. It is also known as Beta (β) error.

This is shown in the following table :

Possible Situations		Possible Outcomes	
		Accept H_0	Reject H_0
	H_0 True	Correct Decision	Type I error
			(α error)
	H_0 False	Type II error	Correct Decision
		(β error)	

When the sample size N is fixed, if we try to reduce Type I error, the chances of making Type II error increase. Both types of errors cannot be reduced simultaneously. More about this will be discussed in the section on statistical analysis of data.

Check Your Progress – III

- What are the major methods of hypothesis testing?
- What are the different types of errors in the hypothesis testing?

6A.5 INTERPRETATION OF DATA AND RESULT

The quantitative data interpretation method is used to analyze quantitative data, which is also known as numerical data. This data type contains numbers and is therefore analyzed with the use of numbers and not texts.

Quantitative data are of 2 main types, namely; discrete and continuous data. Continuous data is further divided into interval data and ratio data, with all the data types being numeric.

Due to its natural existence as a number, analysts do not need to employ the coding technique on quantitative data before it is analyzed. The process of analyzing quantitative data involves statistical modelling techniques such as standard deviation, mean and median.

Some of the statistical methods used in analyzing quantitative data are highlighted below:

- **Mean**

The mean is a numerical average for a set of data and is calculated by dividing the sum of the values by the number of values in a dataset. It is used to get an estimate of a large population from the dataset obtained from a sample of the population.

For example, online job boards in the US use the data collected from a group of registered users to estimate the salary paid to people of a particular profession. The estimate is usually made using the average salary submitted on their platform for each profession.

- **Standard deviation**

This technique is used to measure how well the responses align with or deviates from the mean. It describes the degree of consistency within the responses; together with the mean, it provides insight into data sets.

In the job board example highlighted above, if the average salary of writers in the US is \$20,000 per annum, and the standard deviation is 5.0, we can easily deduce that the salaries for the professionals are far away from each other. This will birth other questions like why the salaries deviate from each other that much.

With this question, we may conclude that the sample contains people with few years of experience, which translates to a lower salary, and people with many years of experience, translating to a higher salary. However, it does not contain people with mid-level experience.

- **Frequency distribution**

This technique is used to assess the demography of the respondents or the number of times a particular response appears in research. It is extremely keen on determining the degree of intersection between data points.

Some other interpretation processes of quantitative data include:

- Regression analysis
- Cohort analysis
- Predictive and prescriptive analysis

Tips for Collecting Accurate Data for Interpretation

- **Identify the Required Data Type**

Researchers need to identify the type of data required for particular research. Is it nominal, ordinal, interval, or ratio data?

The key to collecting the required data to conduct research is to properly understand the research question. If the researcher can understand the research question, then he can identify the kind of data that is required to carry out the research.

For example, when collecting customer feedback, the best data type to use is the ordinal data type. Ordinal data can be used to access a customer's feelings about a brand and is also easy to interpret.

- **Avoid Biases**

There are different kinds of biases a researcher might encounter when collecting data for analysis. Although biases sometimes come from the researcher, most of the biases encountered during the data collection process is caused by the respondent.

There are 2 main biases, that can be caused by the Respondent, namely; response bias and non-response bias. Researchers may not be able to eliminate these biases, but there are ways in which they can be avoided and reduced to a minimum.

Response biases are biases that are caused by respondents intentionally giving wrong answers to responses, while non-response bias occurs when the respondents don't give answers to questions at all. Biases are capable of affecting the process of data interpretation.

- **Use Close Ended Surveys**

Although open-ended surveys are capable of giving detailed information about the questions and allowing respondents to fully express themselves, it is not the best kind of survey for data interpretation. It requires a lot of coding before the data can be analyzed.

Close-ended surveys, on the other hand, restrict the respondents' answers to some predefined options, while simultaneously eliminating irrelevant data. This way, researchers can easily analyze and interpret data.

However, close-ended surveys may not be applicable in some cases, like when collecting respondents' personal information like name, credit card details, phone number, etc.

Visualization Techniques in Data Analysis

One of the best practices of data interpretation is the visualization of the dataset. Visualization makes it easy for a layman to understand the data, and also encourages people to view the data, as it provides a visually appealing summary of the data.

There are different techniques of data visualization, some of which are highlighted below.

Bar Graphs

Bar graphs are graphs that interpret the relationship between 2 or more variables using rectangular bars. These rectangular bars can be drawn either vertically or horizontally, but they are mostly drawn vertically.

The graph contains the horizontal axis (x) and the vertical axis (y), with the former representing the independent variable while the latter is the dependent variable. Bar graphs can be grouped into different types, depending on how the rectangular bars are placed on the graph.

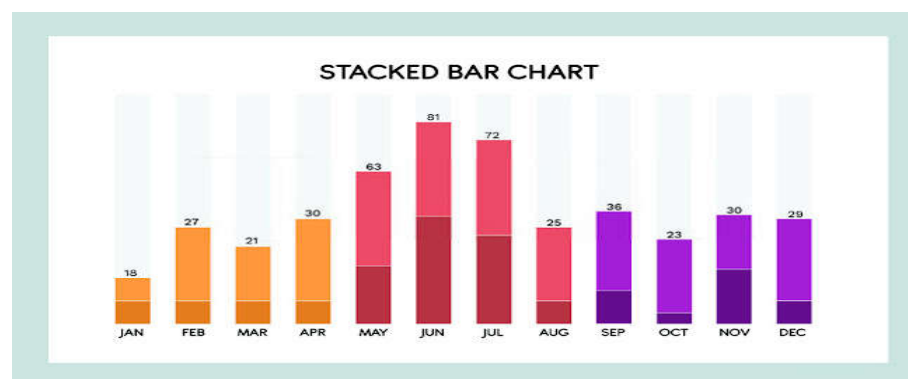
Some types of bar graphs are highlighted below:

- **Grouped Bar Graph**

The grouped bar graph is used to show more information about variables that are subgroups of the same group with each subgroup bar placed side-by-side like in a histogram.

- **Stacked Bar Graph**

A stacked bar graph is a grouped bar graph with its rectangular bars stacked on top of each other rather than placed side by side.



- **Segmented Bar Graph**

Segmented bar graphs are stacked bar graphs where each rectangular bar shows 100% of the dependent variable. It is mostly used when there is an intersection between the variable categories.

Advantages of a Bar Graph

- It helps to summarize a large data
- Estimations of key values can be made at a glance
- Can be easily understood

Disadvantages of a Bar Graph

- It may require additional explanation.
- It can be easily manipulated.
- It doesn't properly describe the dataset.

Pie Chart

A pie chart is a circular graph used to represent the percentage of occurrence of a variable using sectors. The size of each sector is dependent on the frequency or percentage of the corresponding variables.

There are different variants of the pie charts, but for the sake of this article, we will be restricting ourselves to only 3. For better illustration of these types, let us consider the following examples.

Pie Chart Example: There are a total of 50 students in a class, and out of them, 10 students like Football, 25 students like snooker, and 15 students like Badminton.

- **Simple Pie Chart**

The simple pie chart is the most basic type of pie chart, which is used to depict the general representation of a bar chart.

- **Doughnut Pie Chart**

Doughnut pie is a variant of the pie chart, with a blank center allowing for additional information about the data as a whole to be included.

- **3D Pie Chart**

3D pie chart is used to give the chart a 3D look and is often used for aesthetic purposes. It is usually difficult to reach because of the distortion of perspective due to the third dimension.

Advantages of a Pie Chart

- It is visually appealing.
- Best for comparing small data samples.

Disadvantages of a Pie Chart

- It can only compare small sample sizes.
- Unhelpful with observing trends over time.

Tables

Tables are used to represent statistical data by placing them in rows and columns. They are one of the most common statistical visualization techniques and are of 2 main types, namely; simple and complex tables.

- **Simple Tables**

Simple tables summarize information on a single characteristic and may also be called a univariate table. An example of a simple table showing the number of employed people in a community concerning their age group.

- **Complex Tables**

As its name suggests, complex tables summarize complex information and present them in two or more intersecting categories. A complex table example is a table showing the number of employed people in a population concerning their age group and sex as shown in the table below.

Advantages of Tables

- Can contain large data sets
- Helpful in comparing 2 or more similar things

Disadvantages of Tables

- They do not give detailed information.
- Maybe time-consuming.

Line Graph

Line graphs or charts are a type of graph that displays information as a series of points, usually connected by a straight line. Some of the types of line graphs are highlighted below.

- **Simple Line Graphs**

Simple line graphs show the trend of data over time, and may also be used to compare categories. Let us assume we got the sales data of a firm for each quarter and are to visualize it using a line graph to estimate sales for the next year.

- **Line Graphs with Markers**

These are similar to line graphs but have visible markers illustrating the data points

- **Stacked Line Graphs**

Stacked line graphs are line graphs where the points do not overlap, and the graphs are therefore placed on top of each other. Consider that we got

the quarterly sales data for each product sold by the company and are to visualize it to predict company sales for the next year.

Advantages of a Line Graph

- Great for visualizing trends and changes over time.
- It is simple to construct and read.

Disadvantage of a Line Graph

- It can not compare different variables at a single place or time.

What are the Steps in Interpreting Data?

After data collection, you'd want to know the result of your findings. Ultimately, the findings of your data will be largely dependent on the questions you've asked in your survey or your initial study questions. Here are the four steps for accurately interpreting data

1. Gather the data

The very first step in interpreting data is having all the relevant data assembled. You can do this by visualizing it first either in a bar, graph, or pie chart. The purpose of this step is to accurately analyze the data without any bias.

Now is the time to remember the details of how you conducted the research. Were there any flaws or changes that occurred when gathering this data? Did you keep any observatory notes and indicators?

Once you have your complete data, you can move to the next stage

2. Develop your findings

This is the summary of your observations. Here, you observe this data thoroughly to find trends, patterns, or behavior. If you are researching about a group of people through a sample population, this is where you analyze behavioral patterns. The purpose of this step is to compare these deductions before drawing any conclusions. You can compare these deductions with each other, similar data sets in the past, or general deductions in your industry.

3. Derive Conclusions

Once you've developed your findings from your data sets, you can then draw conclusions based on trends you've discovered. Your conclusions should answer the questions that led you to your research. If they do not answer these questions ask why? It may lead to further research or subsequent questions.

4. Give recommendations

For every research conclusion, there has to be a recommendation. This is the final step in data interpretation because recommendations are a

summary of your findings and conclusions. For recommendations, it can only go in one of two ways. You can either recommend a line of action or recommend that further research be conducted.

Advantages and Importance of Data Interpretation

- Data interpretation is important because it helps make data-driven decisions.
- It saves costs by providing costing opportunities
- The insights and findings gotten from interpretation can be used to spot trends in a sector or industry.

Conclusion

Data interpretation and analysis is an important aspect of working with data sets in any field or research and statistics. They both go hand in hand, as the process of data interpretation involves the analysis of data.

The process of data interpretation is usually cumbersome, and should naturally become more difficult with the best amount of data that is being churned out daily. However, with the accessibility of data analysis tools and machine learning techniques, analysts are gradually finding it easier to interpret data.

Data interpretation is very important, as it helps to acquire useful information from a pool of irrelevant ones while making informed decisions. It is found useful for individuals, businesses, and researchers.

Suggested Readings

1. Guilford, J. P. and Fruchter, B. *Fundamental Statistics in psychology and Education*. Singapore : McGraw –Hill Book Company.1981.
2. Best, J. and Kahn, J. Research in Education (9 ed), NewDelhi: Prentice Hall of India Pvt. Ltd.2006.
3. Garret, H. E. Statistics in Psychology and Education. NewYork: Longmans Green and Co. 5th edition1958.
4. <https://www.formpl.us/blog/data-interpretation>



DATA ANALYSIS AND REPORT WRITING-II (QUALITATIVE DATA ANALYSIS)

Unit Structure:

6B.0 Objectives

6B.1 Introduction

6B.2 Qualitative Data Analysis

- Data Reduction and Classification
- Analytical Induction
- Constant Comparison

6B.0 OBJECTIVES:

After reading this unit the student will be able to:

- Explain the meaning of qualitative data analysis.
- State the broad focus of qualitative research.
- State the specific research questions usually formulated in qualitative research.
- State the principles and characteristics of qualitative data analysis.
- Explain the strategies of qualitative data analysis.

6B.1 INTRODUCTION:

Meaning: Qualitative data analysis is the array of processes and procedures whereby a researcher provides explanations, understanding and interpretations of the phenomenon under study on the basis of meaningful and symbolic content of qualitative data. It provides ways of discerning, examining, comparing and contrasting and interpreting meaningful patterns and themes. Meaningfulness is determined by the specific goals and objectives of the topic at hand wherein the same set of data can be analysed and synthesised from multiple angles depending on the research topic. It is based on the interpretative philosophy. Qualitative data are subjective, soft, rich

and in-depth descriptions usually presented in the form of words. The most common forms of obtaining qualitative data include semi- structured and unstructured interviews, observations, life histories and documents. The process of analysing is difficult rigorous.

Broad Focus of Qualitative Research :These include finding answers to the following questions:

- What is the interpretation of the world from the participants' perspective?
- Why do they have a particular perspective?
- How did they develop such a perspective?
- What are their activities?
- How do they identify and classify themselves and others?
- How do they convey their perspective of their situation?
- What patterns and common themes surface in participants' responses dealing with specific items? How do these patterns shed light on the broader study questions?
- Are there any deviations from these patterns? If so, are there any factors that might explain these atypical responses?
- What stories emerge from these responses? How do these stories help in illuminating the broader study questions?
- Do any of these patterns or findings suggest additional data that may be required? Do any of the study questions need to be revised?
- Do the patterns that emerge substantiate the findings of any corresponding qualitative analysis that have been conducted? If not, what might explain these discrepancies?

Specific Research Questions Usually Formulated in Qualitative Research

- What time did school start in the morning?
- What would students probably have to do before going to school?
- What was the weather like in the month of data collection?
- How did the students get from home to school?
- What were the morning activities?
- What did the students do in the recess?
- What were the activities after recess?

- What was the classroom environment like?
- What books and instructional materials were used?
- At what time did the school got over?
- What would students probably have to do after school got over?
- What kind of homework was given and how much time it required?

Before describing the process of qualitative data analysis process, it is necessary to describe the terms associated with process.

Principles of Qualitative Data Analysis

These are as follows;

- 1 Proceeding systematically and rigorously (minimize human error).
- 2 Recording process, memos, journals, etc.
- 3 Focusing on responding to research questions.
- 4 Identifying appropriate level of interpretation suitable to a situation.
- 5 Simultaneous process of inquiry and analysis.
- 6 Seeking to explain or enlighten.
- 7 Evolutionary/emerging.

Characteristics of Qualitative Data Analysis:

According to Seidel, the process has the following characteristics :

- a. **Iterative and Progressive:** The process is iterative and progressive because it is a cycle that keeps repeating. For example, if you are *thinking* about things, you also start *noticing new things* in the data. You then *collect* and *think* about these new things. In principle the process is an infinite spiral.
- b. **Recursive:** The process is recursive because one part can call you back to a previous part. For example, while you are busy collecting things, you might simultaneously start *noticing* new things to *collect*.
- c. **Holographic:** The process is holographic in that each step in the process contains the entire process. For example, when you first Notice things, you are already mentally collecting and thinking about those things.

6B.2 COMPONENTS OF QUALITATIVE DATA ANALYSIS

According to Miles and Huberman, following are the major components of qualitative data analysis :

(A)Data Reduction:"Data reduction refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions." First, the mass of data has to be organized and somehow meaningfully reduced or reconfigured. These data are condensed so as to make them more manageable. They are also transformed so that they can be made intelligible in terms of the issues being addressed. Data reduction often forces choices about which aspects of the accumulated data should be emphasised, reduced or set aside completely for the purposes of the topic at hand. Data in themselves do not reveal anything and hence it is not necessary to present a large amount of unassimilated and uncategorized data for the reader's consumption in order to show that you are "perfectly objective". In qualitative analysis, the researcher uses the principle of selectivity to determine which data are to be singled out for description. This usually involves some combination of deductive and inductive analysis. While initial categorizations are shaped by pre-established research questions, the qualitative researcher should remain open to inducing new meanings from the data available. Data reduction should be guided primarily by the need to address the salient question(s) in a research. This necessitates selective winnowing/sifting which refers to removing data from a group so that only the best ones which are relevant for answering particular research questions are left. This is difficult as not only qualitative data are very rich but also because the person who analyses the data also often plays a direct, personal role in collecting them. The process of data reduction starts with a focus on distilling what the different respondents report about the activity, practice or phenomenon under study to share knowledge. The information given by various categories of sample is now compared – such as the information given by experienced and new teachers or the information given by teachers, principal, students and/or parents about central themes of the research. In setting out these similarities and dissimilarities, it is important not to so "flatten" or reduce the

data that they sound like close-ended survey responses. The researcher should ensure that the richness of the data is not unfairly and unnecessarily diluted. Apart from exploring the specific content of the respondents' views, it is also a good idea to take note of the relative frequency with which different issues are raised, as well as the intensity with which they are expressed.

(B)Data Display :Data display provides "an organized, compressed assembly of information that permits conclusion drawing..." A display can be an extended piece of text or a diagram, chart or matrix that provides a new way of arranging and thinking about the more textually embedded data. Data displays, permits the researcher to extrapolate from the data enough to begin to identify systematic patterns and interrelationships. At the display stage, additional, higher order categories or themes may emerge from the data that go beyond those first discovered during the initial process of data reduction. Data display can be extremely helpful in identifying whether a system is working effectively and how to change it. The qualitative researcher needs to discern patterns of among various

concepts so as to gain a clear understanding of the topic at hand. Data could be displayed using a series of flow charts that map out any critical paths, decision points, and supporting evidence that emerge from establishing the data for each site. The researcher may (1) use the data from subsequent sites to modify the original flow chart of the first site, (2) prepare an independent flow chart for each site; and/or (3) prepare a single flow chart for some events (if most sites adopted a generic approach) and multiple flow charts for others.

(C) Conclusion Drawing and Verification : Conclusion drawing requires a researcher to begin to decide what things mean. He does this by noting regularities, patterns (differences/similarities), explanations, possible configurations, causal flows, and propositions. This process involves stepping back to consider what the analysed data mean and to assess their implications for the questions at hand. Verification, integrally linked to conclusion drawing, entails revisiting the data as many times as necessary to cross-check or verify these emergent conclusions. Miles and Huberman assert that "The meanings emerging from the data have to be tested for their plausibility, their sturdiness, their confirmability' that is, their validity". Validity in this context refers to whether the conclusions being drawn from the data are credible, defensible, warranted, and able to withstand alternative explanations. When qualitative data are used with the intension of identifying dimensions/aspects of a concept for designing/developing a quantitative tool, this step may be postponed. Reducing the data and looking for relationships will provide adequate information for developing other instruments.

Miles and Huberman describe several tactics of systematically examining and re-examining the data including noting patterns and themes, clustering cases, making contrasts and comparisons, partitioning variables and subsuming particulars in the general which can be employed simultaneously and iteratively for drawing conclusions in a qualitative research. This process is facilitated if the theoretical or logical assumptions underlying the research are stated clearly. They further identify 13 tactics for testing or confirming findings, all of which address the need to build systematic "safeguards against self-delusion" into the process of analysis.

THE PROCEDURES OF QUALITATIVE DATA ANALYSIS

These are as follows:

- 1 Coding/indexing
- 2 Categorisation
- 3 Abstraction
- 4 Comparison
- 5 Dimensionalisation
- 6 Integration
- 7 Iteration

- 8 Refutation (subjecting inferences to scrutiny)
- 9 Interpretation (grasp of meaning - difficult to describe procedurally)

Steps of Qualitative Data Analysis

The Logico-Inductive process of data analysis is as follows;

- Analysis is logico-inductive.
- Data are mostly verbal.
- Observations are made of behaviours, situations, interactions, objects and environment.
- Becoming familiar with the data.
- Data are examined in depth to provide detailed descriptions of the setting, participants and activity(describing).
- Coding pieces of data.
- Grouping them into potential themes (classifying) which are identified from observations through (reading /memoing).
- Themes are clustered into categories.
- Categories are scrutinised to discover patterns.
- Explanations are made from patterns.
- Interpreting and synthesizing the organised data into general written conclusions or understandings based on what is observed and are stated verbally (interpreting).
- These conclusions are used to answer research questions.

Terms associated with Qualitative Data Analysis:

- Data : It is the information obtained in the form of words.
- Category : It is a classification of ideas and concepts. When concepts in the data are examined and compared with one another and connections are made, categories are formed. Categories are used to organise similar concepts into distinct groups.
- Pattern : It is a link or the relationship between two or more categories that further organises the data and that usually becomes the primary basis of organising and reporting the outcomes of the study. Pattern seeking means examining the data in as many ways as possible through understanding the complex links between situations, processes, beliefs and actions.

Qualitative data analysis is a predominantly an inductive process of organizing data into categories and patterns (relationship) among the categories.

Seidel identifies three major types of codes in qualitative analysis of data:

1. **Descriptive Coding** : This is when coding is used to describe what is in the data.
2. **Objectivist Coding** : According to Seidel and Kelle, an objectivist approach treats code words as —condensed representation of the facts described in the data .Given this assumption, code words can be treated as substitutes for the text and the analysis can focus on the codes instead of the text itself. You can then imitate traditional distributional analysis and hypothesis testing for qualitative data. But first you must be able to trust your code words. To trust a code word you need: 1) to guarantee that every time you use a code word to identify a segment of text that segment is an unambiguous instance of what that code word represents, 2) to guarantee that you applied that code word to the text consistently in the traditional sense of the concept of reliability, and 3) to guarantee that you have identified every instance of what the code represents. If the above conditions are met, then: 1) the codes are adequate surrogates for the text they identify, 2) the text is reducible to the codes, and 3) it is appropriate to analyze relationships among codes. If you fall short of meeting these conditions then an analysis of relationships among code words is risky business.
3. **Heuristic Coding** : In a heuristic approach, code words are primarily flags or signposts that point to things in the data. The role of code words is to help you collect the things you have noticed so you can subject them to further analysis. Heuristic codes help you reorganize the data and give you different views of the data. They facilitate the discovery of things, and they help you open up the data to further intensive analysis and inspection. The burdens placed on heuristic codes are much less than those placed on objective codes. In a heuristic approach code words more or less represent the things you have noticed. You have no assurance that the things you have coded are always the same type of thing, nor that you have captured every possible instance of that thing in your coding of the data. This does not absolve you of the responsibility to refine and develop your coding scheme and your analysis of the data. Nor does it excuse you from looking for counterexamples and confirming examples in the data. The heuristic approach does say that coding the data is never enough. It is the beginning of a process that requires you to work deeper and deeper into your data. Further, heuristic code words change and evolve as the analysis develops. The way you use the same code word changes over time. Text coded at time one is not necessarily equivalent with text coded at time two. Finally, heuristic code words change and transform the researcher who, in turn, changes and transforms the code words as the analysis proceeds.

Bogdan and Biklen (1998) provide common types of coding categories, but emphasize that your hypotheses shape your coding scheme.

Setting/Context codes provide background information on the setting, topic, or subjects.

1. Defining the Situation codes categorize the world view of respondents and how they see themselves in relation to a setting or your topic.
2. Respondent Perspective codes capture how respondents define a particular aspect of a setting. These perspectives may be summed up in phrases they use, such as, "Say what you mean, but don't say it mean."
3. Respondents' Ways of Thinking about People and Objects codes capture how they categorize and view each other, outsiders, and objects. For example, a dean at a private school may categorize students: "There are crackerjack kids and there are junk kids."
4. Process codes categorize sequences of events and changes overtimes.
5. Activity codes identify recurring informal and formal types of behaviour.
6. Event codes, in contrast, are directed at infrequent or unique happenings in the setting or lives of respondents.
7. Strategy codes relate to ways people accomplish things, such as how instructors maintain students' attention during lectures.
8. Relationship and social structure codes tell you about alliances, friendships, and adversaries as well as about more formally defined relations such as social roles.
9. Method codes identify your research approaches, procedures, dilemmas, and breakthroughs.

Check Your Progress - I

- (a) State the components of qualitative data analysis.
- (b) Which are the different types of codes used in qualitative research in education?
- (c) What are the terms associated with qualitative data analysis?
- (d) Explain the steps of qualitative data analysis.

STRATEGIES OF QUALITATIVE DATA ANALYSIS:

Some of these are as follows:

A. Analytical Induction : Analytic induction is a way of building explanations in qualitative analysis by constructing and testing a set of causal links between events, actions etc. in one case and the iterative

extension of this to further cases. It is research logic used to collect, develop analysis and organize the presentation of research findings. It refers to a systematic and exhaustive examination of a limited number of cases in order to provide generalizations and identify similarities between various social phenomena in order to develop concepts or ideas. Its formal objective is causal explanation. It has its origin in the theory of symbolic interaction which stipulates that a person's actions are built up and evolve over time through processes of learning, trial-and-error and adjustment to responses by others. This helps in searching for broad categories followed by development of subcategories. If no relevant similarities can be identified, then either the data needs to be re-evaluated and the definition of similarities changed, or the category is too wide and heterogeneous and should be narrowed down. In analytical induction, definitions of terms are not identified/ determined at the beginning of research. They are rather, considered hypotheses to be tested using inductive reasoning. It allows for modification of concepts and relationships between concepts aimed at representing reality of the situation most accurately.

According to Katz, "Analytic induction (AI) is a research logic used to collect data, develop analysis, and organize the presentation of research findings. Its formal objective is causal explanation, a specification of the individually necessary and jointly sufficient conditions for the emergence of some part of social life. AI calls for the progressive redefinition of the phenomenon to be explained (the explanandum) and of explanatory factors (the explanans), such that a perfect (sometimes called "universal") relationship is maintained. Initial cases are inspected to locate common factors and provisional explanations. As new cases are examined and initial hypotheses are contradicted, the explanation is reworked in one or both of two ways. The definition of the explanandum may be redefined so that troublesome cases either become consistent with the explanans or are placed outside the scope of the inquiry; or the explanations may be revised so that all cases of the target phenomenon display the explanatory conditions. There is no methodological value in piling up confirming cases; the strategy is exclusively qualitative, seeking encounters with new varieties of data in order to force revisions that will make the analysis valid when applied to an increasingly diverse range of cases. The investigation continues until the researcher can no longer practically pursue negative cases."

Usually, three explanatory mechanisms are available for presenting the findings in analytical induction as follows:

- (b) Practicalities of action.
- (c) Self-awareness and self-regard.
- (d) Sensual base of motivation in desires, emotions or a sense of compulsion to act.

The steps of analytical induction process are as follows :

- a) Develop a hypothetical statement drawn from an individual instance.

- b) Compare that hypothesis with alternative possibilities taken from other instances. Thus the social system provides categories and classifications, rather than being imposed upon the social system. Progress in the social sciences is escalated further by comparing aspects of a social system with similar aspects in alternative social systems. The emphasis in the process is upon the whole, even though elements are analysed as are relationships between those elements. It is not necessary that the specific cases being studied are average or representative of the phenomena.

According to Cressey, the steps of analytical induction process are as follows :

- a) A phenomenon is defined in a tentative manner.
- b) A hypothesis is developed about it.
- c) A single instance is considered to determine if the hypothesis is confirmed.
- d) If the hypothesis fails to be confirmed, either the phenomenon is redefined or the hypothesis is revised so as to include the instance examined.
- e) Additional cases are examined, and if the new hypothesis is repeatedly confirmed, some degree of certainty about the hypothesis is ensured.
- f) Each negative case requires that the hypothesis be reformulated until there are no exceptions.

B. Constant Comparison : Many writers suggest about the ways of approaching your data so that you can do the coding of the data with an open mind and recognize noteworthy patterns in the data. Perhaps the most famous are those made by the grounded theorists. This could be done through constant comparison method. This requires that every time you select a passage of text (or its equivalent in video etc.) and code it, you should compare it with all those passages you have already coded that way, perhaps in other cases. This ensures that your coding is consistent and allows you to consider the possibility either that some of the passages coded that way do not fit as well and could therefore be better codes as something else or that there are dimensions or phenomena in the passages that might well be coded another way as well. But the potential for comparisons does not stop there. You can compare the passage with those codes in similar or related ways or even compare them with cases and examples from outside your data set altogether. Previously coded text also needs to be checked to see if the new codes created are relevant. Constant comparison is a central part of grounded theory. Newly gathered data are continually compared with previously collected data and their coding in order to refine the development of theoretical categories. The purpose is to test emerging ideas that might take the research in new and fruitful directions. In the case of far out comparisons, the comparison is made with cases and situations that are similar in some respects but quite different in

others and may be completely outside the study. For example, still thinking about parental help, we might make a comparison with the way teachers help students. Reflecting on the similarities and differences between teaching and parental relationships might suggest other dimensions to parental help, like the way that teachers get paid for their work but parents do not.

Ryan and Bernard suggest a number of ways in which those coding transcripts can discover new themes in their data. Drawing heavily on Strauss and Corbin (1990) they suggest these include:

- a. **Word repetitions** : Look for commonly used words and words whose close repetition may indicated emotions
- b. **Indigenous categories** (what the grounded theorists refer to as *in vivo* codes) : It refers to terms used by respondents with a particular meaning and significance in their setting.
- c. **Key-words-in-context** : Look for the range of uses of key terms in the phrases and sentences in which they occur.
- d. **Compare and contrast** : It is essentially the grounded theory idea of constant comparison. Ask ,what is this about? ‘and how does it differ from the preceding or following statements?’
- e. **Social science queries** : Introduce social science explanations and theories, for example, to explain the conditions, actions, interaction and consequences of phenomena.
- f. **Searching for missing information** : It is essential to try to get an idea of what is not being done or talked out, but which you would have expected to find.
- g. **Metaphors and analogies** : People often use metaphor to indicate something about their key, central beliefs about things and these may indicate the way they feel about things too.
- h. **Transitions** : One of the discursive elements in speech which includes turn-taking in conversation as well as the more poetic and narrative use of story structures.
- i. **Connectors** : It refers to connections between terms such as causal (‘since’, ‘because’, ‘as’ etc) or logical(‘implies’, ‘means’, ‘is one of’ etc.)
- j. **Unmarked text** : Examine the text that has not been coded at a theme or even not at all.
- k. **Pawing (i.e. handling)** : It refers to marking the text and eyeballing or scanning the text. Circle words, underline, use coloured highlighters, run coloured lines down the margins to indicate different meanings and coding. Then look for patterns and significances.

1. **Cutting and sorting** : It refers to the traditional technique of cutting up transcripts and collecting all those coded the same way into piles, envelopes or folders or pasting them onto cards. Laying out all these scraps and re-reading them, together, is an essential part of the process of analysis.

C. Triangulation ; According to Berg and Berg, triangulation is a term originally associated with surveying activities, map making, navigation and military practices. In each case, there are three known objects or points used to draw sighting lines towards an unknown point or object. Usually, these three sighting lines will intersect forming a triangle known as the triangle of error. Assuming that the three lines are equal in error, the best estimated place of the new point or object is at the centre of the triangle. The word triangulation was first used in the social sciences as metaphor describing a form of multiple operationalisation or convergent validation. Campbell and Fiske were the first to apply the navigational term triangulation to research. The simile is quite appropriate because a phenomenon under study in a qualitative research is much like a ship at sea as the exact description of the phenomenon in a qualitative research is unclear. They used the term triangulation to describe multiple data collection strategies for measuring a single concept. This is known as data triangulation. According to them, triangulation is a powerful way of demonstrating concurrent validity, particularly in qualitative research. Later on, Denzin introduced another metaphor, viz., ‘line of action’ which characterises the use of multiple data collection strategies (usually three), multiple theories, multiple researchers, multiple methodologies or a combination of these four categories of researcher activities. This is aimed at mutual confirmation of measures and validation of findings. The purpose of triangulation is not restricted to combining different kinds of data but to relate them so as enhance the validity of the findings.

Triangulation is an approach to research that uses a combination of more than one research strategy in a single investigation. Triangulation can be a useful tool for qualitative as well as quantitative researchers. The goal in choosing different strategies in the same study is to balance them so each counterbalances the margin of error in the other.

Used with care, it contributes to the completeness and confirmation of findings necessary in qualitative research investigations.

Choosing Triangulation as a Research Strategy

Qualitative investigators may choose triangulation as a research strategy to assure completeness of findings or to confirm findings. The most accurate description of the elephant comes from a combination of all three individuals' descriptions. Researchers might also choose triangulation to confirm findings and conclusions. Any single qualitative research strategy has its limitations. By combining different strategies, researchers confirm findings by overcoming the limitations of a single strategy. Uncovering the same information from more than one vantage point helps researchers describe how the findings occurred under different circumstances and assists them to confirm the validity of the findings.

Types of Triangulation

1. Data Triangulation : Time, Space, Person
2. Method Triangulation : Design, Data Collection
3. Investigator Triangulation
4. Theory Triangulation
5. Multiple Triangulation. which uses a combination of two or more triangulation techniques in one study.

Each of these are described in detail in the following paragraphs

1. Data Triangulation

According to Denzin (1989) there are three types of data triangulation: (a) time, (b) space, and (c) person.

(a) Time Triangulation :Here, the researcher/s collect data about a phenomenon at different points in time. However, studies based on longitudinal designs are not considered examples of data triangulation for time because they are intended to document changes over time. Triangulations of data analysis in cross sectional and longitudinal research is an example of time triangulation.

(b) Space Triangulation :It consists of collecting data at more than one site. At the outset, the researcher must identify how time or space relate to the study and make an argument supporting the use of different time or space collection points in the study. By collecting data at different points in time and in different spaces, the researcher gains a clearer and more complete description of decision making and is able to differentiate characteristics that span time periods and spaces from characteristics specific to certain times and spaces.

(c) Person Triangulation: According to Denzin, person triangulation has three levels, viz., aggregate, interactive and collective. It is also known as combined levels of triangulation. Here researchers collect data from more than one level of person, that is, a set of individuals, groups, or collectives. Researchers might also discover data that are dissimilar among levels. In such a case, researchers would collect additional data to resolve the incongruence. According to Smith, there are seven levels of 'person triangulation' as follows:

- i. The Individual Level.
- ii. Group Analysis : The interaction patterns of individuals and groups.
- iii. Organisational Units of Analysis : Units which have qualities not possessed by the individuals making them up.
- iv. Institutional Analysis : Relationships within and across the legal (For example, Court, School), political (For example, Government),

economic (For example, Business) and familial (For example, Marriage) institutions of the society.

- v. Ecological Analysis : Concerned with spatial explanation.
- vi. Cultural Analysis : Concerned with the norms, values, practices, traditions and ideologies of a culture.
- vii. Societal Analysis : Concerned with gross factors such as urbanisation, industrialisation, education, wealth, etc.

2. Methods Triangulation

Methods triangulation can occur at the level of (a) design or (b) data collection.

(a) Design Level Triangulation: Methods triangulation at the design level has also been called between-method triangulation. Design methods triangulation most often uses quantitative methods combined with qualitative methods in the study design. There is simultaneous and sequential implementation of both quantitative and qualitative methods. Theory should emerge from the qualitative findings and should not be forced by researchers into the theory they are using for the quantitative portion of the study. The blending of qualitative and quantitative approaches does not occur during either data generation or analysis. Rather, researchers blend these approaches at the level of interpretation, merging findings from each technique to derive a consistent outcome. The process of merging findings "is an informed thought process, involving judgment, wisdom, creativity, and insight and includes the privilege of creating or modifying theory". If contradictory findings emerge or researchers find negative cases, the investigators most likely will need to study the phenomenon further. Sometimes triangulation design method might use two different qualitative research methods. When researchers combine methods at the design level, they should consider the purpose of the research and make a logical argument for using each method.

(b) Data Collection Triangulation :Methods triangulation at the data collection level has been called within-method triangulation. Using methods triangulation at the level of data collection, researchers use two different techniques of data collection, but each technique is within the same research tradition. The purpose of combining the data collection methods is to provide a more holistic and better understanding of the phenomenon under study. It is not an easy task to use method triangulation; it is often more time consuming and expensive to complete a study using methods triangulation.

3. Investigator Triangulation

Investigator triangulation occurs when two or more researchers with divergent backgrounds and expertise work together on the same study. To achieve investigator triangulation, multiple investigators each must have prominent roles in the study and their areas of expertise must be

complementary. All the investigators discuss their individual findings and reach a conclusion, which includes all findings. Having a second research expert examine a data set is not considered investigator triangulation. Use of methods triangulation usually requires investigator triangulation because few investigators are expert in more than one research method.

4. Theory Triangulation

Theory triangulation incorporates the use of more than one lens or theory in the analysis of the same data set. In qualitative research, more than one theoretical explanation emerges from the data. Researchers investigate the utility and power of these emerging theories by cycling between data generation and data analysis until they reach a conclusion.

5. Multiple Triangulation

It uses a combination of two or more preceding triangulation techniques in one study.

Reducing Bias in Qualitative Data Analysis:

Bias can influence the results. The credibility of the findings can be increased by:

a. Using multiple sources of data. Using data from different sources helps in cross-checking the findings. For example, combine and compare data from individual interviews with data from focus groups and an analysis of written material on the topic. If the data from these different sources point to the same conclusions, the findings are more reliable.

b. Tracking choices. The findings of the study will be more credible if others understand how the conclusions were drawn. Keep notes of all analytical decisions to help others follow the reasoning. Document reasons for the focus, category labels created, revisions to categories made and any observations noted concerning the data while reading and re-reading the text.

c. Document the process used for data analysis. People often see and read only what supports their interest or point of view. Everyone sees data from his or her perspective. It is important to minimise this selectivity. State how data was analysed clearly so that others can see how decisions were made, how the analysis was completed and how the interpretations were drawn.

d. Involving others. Getting feedback and input from others can help with both analysis and interpretation. Involve others in the entire analysis process, or in any one of the steps. Have several people or another person review the data independently to identify themes and categories. Then compare categories and resolve any discrepancies in meaning.

Drawbacks to be Avoided:

- a. Do not generalise results. The goal of qualitative work is not to generalise across a population. Rather, a qualitative data collection approach seeks to provide understanding from the respondent's perspective. It tries to answer the question –why. Qualitative data provide for clarification, understanding and explanation, not for generalizing.
- b. Choose quotes carefully. Use of quotes can not only provide valuable support to data interpretation but is also useful in directly supporting the argument or illustrate success. However, avoid using people's words out of context or editing quotes to exemplify a point. Use quotes keeping in mind the purpose for including quotes. Include enough of the text to allow the reader to decide what the respondent is trying to convey.
- c. Respect confidentiality and anonymity when using quotes. Even if the person's identity is not noted, others might be able to identify the person making the remark. Therefore, get people's permission to use their words.
- d. Be aware of, state and deal with limitations. Every study has limitations. Presenting the problems or limitations encountered when collecting and analysing the data helps others understand the conclusions more effectively.

Check Your Progress – II

Explain the meaning of the following terms :

- (a) Analytical Induction:
- (b) Constant Comparison:
- (c) triangulation:

SUGGESTED READINGS

Bogdan R. B. and Biklen, S. K. Qualitative Research for Education: An Introduction to Theory and Methods. Third Edition. Needham Heights, MA: Allyn and Bacon. 1998.

Miles, M. B. and Huberman, M. A. Qualitative Analysis : An Expanded Sourcebook. Thousand Oaks, CA: Sage. 1994.

Katz, J. "Analytic Induction," in Smelser and Baltes, (eds) International Encyclopedia of the Social and Behavioral Sciences. 2001.

Ragin, C. C. Constructing Social Research: The Unity and Diversity of Method. Pine Forge Press, 1994.

Strauss, A. and Corbin, J. Basics of Qualitative Research. Grounded Theory Procedures and Techniques. Newbury Park, CA : Sage. 1990.



DATA ANALYSIS AND REPORT WRITING-III (RESEARCH REPORTING)

Unit Structure:

6C.0 Objectives

6C.1 Introduction

6C.2 Meaning and purpose of Research Report

6C.3 Types of Research Report

6C.3.1 Format

6C.3.2 Style

6C.3.3 Mechanism of report writing with reference to Dissertation and thesis and papers.

6C.4 Bibliography

6C. 5 Evaluation of Research Report

6C.0 OBJECTIVES:

After reading this unit, the student will be able to

- Decide the style, format and mechanisms of writing a research report.
- Write down bibliography correctly and comprehensively.
- Explain how to write a research report.

6C.1 INTRODUCTION:

Educational research is shared and communicated to others for dissemination of knowledge. After completion of research activities, the researcher has to report the entire activities that are involved in research process systematically in writing. For clear and easy understanding of readers, writing a good research report requires knowledge of the types of research reporting, rules for writing and typing, format and style of research reporting and the body of the report. However, scholarship, precision of thought and originality of a researcher cannot be undermined in producing a good research report.

6C.2 MEANING AND PURPOSE OF RESEARCH REPORT

1. Meaning of Research Report:

The purpose of research report is to convey the interested persons the whole result of study in sufficient detail and to determine himself the validity of the conclusions. As the culmination of the research investigation, the research report contains a description of different stages of the survey and the conclusions arrived at. Thus it is an end product of a research activity which gives an account of a long journey on the path of finding a new knowledge or modified knowledge.

Writing a research report is a technical task as it requires not only skill on the part of the researcher but also considerable effort, patience and penetration, an overall approach to the problem, data and analysis along with grasp over language and greater objectivity, all springing from considerable thought.

Writing a research report also involves adequate planning and a vast amount of preparation. That apart, perfection of research report is also attributed to coherence of thought, creativity and intelligence of the researcher.

Although a definite standard criterion for the organisation is not possible, a good report writer should always be conscious about the effective and purposeful communication with the society by conveying the interested persons the entire outcome of the study so as to ensure each reader to comprehend the data and to enable himself to cognize the validity of the conclusions. Consideration of certain questions like who says 'what is it about', 'to whom', 'in what manner' and 'of what use' will enable the researcher in preparing a standard research report.

No uniform research report can be prepared to cater to the needs of different categories of audiences. The report should always incorporate the material which will be of interest to the target audience, may that be investigator of fundamental research or applied research, practitioners, policy formulators, funding agents or sponsors or even the general public. To a report writer, the prima facie task may appear an easy affair. But in real terms this is a herculean task as uncertainty about target group results in ineffective communication.

2. Purpose of Research Report:

A good research report not only disseminates knowledge, but also presents the findings for expansion of the horizon of knowledge. That apart, it also checks the validity of the generalization and inspires others to carry on related or allied problems.

The purpose of the research report may be discussed under the following heads:

1. Transmission of Knowledge:

The knowledge that has been obtained on the basis of research need transmission for proper utilization of the resources invested. Because of that reason, it is always advisable to prepare to report in a written manner so that it can also provide knowledge to layman in understanding various social problems.

2. Presentation of Findings:

ADVERTISEMENTS:

Society is more concerned with the finished product in terms of output of research which has the input of immense money, human resources and precious time. Therefore, the social utility of the research report lies in its exposure to the laymen as well as its submission to the sponsoring agency of the project.

Whereas people may acquire knowledge about various social problems in the widest possible manner, the sponsoring agency may take the credit of the conduct of a piece of successful research. Even interesting findings may draw the attention of the world community through mass media. That apart, it may also result in legislative or ameliorative, measures.

3. Examining the Validity of the Generalizations:

Submission of the report enables the researchers to examine the validity and the authenticity of the generalizations. For that purpose the report must be prepared and presented in an organized form. Thereafter it can be checked and the discrepancy, if any, in generalizations, practical or real can be dispelled and the facts can be re-examined and reorganized.

4. Inspiration for Further Research:

Research report inspires others to undertake further research in the same line or in any other inter-disciplinary fields. If the report appears to be interesting and a novel one, it is more likely to draw the attention of the social scientists.

Planning and Organisation of a Report:

At the outset, before the commencement of report writing, the researcher needs accurate planning and organisation of study materials to be used prudently. Simple accumulation of masses of data would not make proper sense, only when such data are arranged in a logical and coherent manner within the framework of overall structure those are construed to be planned and organized.

When proper planning and organisation are made the following positive outcomes are obtained:

- (i) Ideas and data are screened, i.e. only those ideas and data having relevance to the study are incorporated and the rest are left out;
- (ii) The report is marked by greater synthesis of facts with clear-cut explanation;
- (iii) The output of research becomes easily intelligible to the readers;
- (iv) Transition in passing of ideas are smoothened;
- (v) Presents facts sequentially and maintains their unity; and
- (vi) Provides the readers with a comprehensive report in a well integrated manner.

6C.3 TYPES OF RESEARCH REPORT:

Research reports mainly take the form of a thesis, dissertation, journal article and a paper to be prescribed at a professional meeting. Research reports vary in format and style. For example, there are difference found in a research report prepared as a thesis or dissertation and a research report prepared as a manuscript for publication.

The dissertation and thesis are more elaborate and comprehensive. While research papers prepared for journal articles and professional meeting are more precise and concise.

6C.3.1 Format:

Format refers to the general pattern of organisation and arrangement of the report. It is an outline that includes sections and subsections or chapters and subchapters or headings and subheadings followed to write research report. All research reports follow a format that is parallel to the steps involved in conducting a study. The format of a research report is generally well spelled out in contents. Different universities, institutions and organizations publishing professional journals follow style manual prepared on their own. Some institutions follow by style manuals prepared by other professional bodies like the American Psychological Associations, the University of Chicago and the Harvard Law Review Association. The Publication Manual of the American Psychological Association (APA), the Chicago Manual of Style, and A Uniform System of Citation (USC) published by Harvard Review Association are some of the worth mentioning style manuals that are followed by researchers to follow format and style while writing research reports.

The APA format is widely followed because it eliminates formal footnotes. It provides detailed information about research format for all types of research reports on various behavioural and social science disciplines. The CMC presents guidelines for use of quotations, abbreviations, names and terms and distinctive treatment of words, numbers, tables, mathematics in type and writing footnotes. Some historians and ethnographers prefer to use the CMC and USC.

The common format used to write research report of quantitative studies for a degree requirement is as follows.

Preliminary pages

1. Title Page
 - a) Title
 - b) Degree requirement
 - c) University or institution's name
 - d) Author's name
 - e) Supervisor's name
 - f) University Department
 - g) Year
2. Acknowledgements
3. Supervisor's Certificate
4. Table of contents
5. List of Tables
6. List of Figures

Main Body the Report

1. Chapter – I :Introduction
 - a. Theoretical Framework
 - b. Rationale of the study
 - c. Statement of the problem
 - d. Definitions of terms
 - e. Objectives
 - f. Hypothesis
 - g. Scope and Delimitations of the study
 - h. Significance of the study
2. Chapter II : Review of Related Literature
3. Chapter III : Methodology and Procedures
 - a. Design and Research method
 - b. Population and sample
 - c. Tools and techniques of data collection
 - d. Techniques of data analysis
4. Data Analyses
5. Results and Discussions

6. Conclusions and Recommendations
7. Bibliography
8. Appendices

The common format followed for qualitative research including historical and analytical research is different from the format followed in quantitative research. The common format used usually to write research report of qualitative studies for degree requirements is as follows.

1. Preliminary pages (same as in quantitative research)
2. Introduction
 - a) General problem statement
 - b) Preliminary Research Review
 - c) Foreshadowed Problems
 - d) Significance of the study
 - e) Delimitations of the study
3. Design and Methodology
 - a) Site selection
 - b) Researcher's Role
 - c) Purposeful / Theoretical Sampling
 - d) Data collection strategies
4. Qualitative Data analysis and Presentation
5. Presentation of Findings : An Analytical interpretation
6. Bibliography
7. Appendices

The common format followed for writing a research report as an article or a paper for a journal and seminar is as follows:

1. Title and author's name and address
2. Abstract
3. Introduction
4. Method
 - a) Sample
 - b) Tools
 - c) Procedure
5. Results
6. Discussions
7. References

1. What is the format of writing a dissertation?

6C.3.2 Style :

Style refers to the rules of spelling, capitalization, punctuations and typing followed in preparing the report. A researcher has to follow some general rules for writing and typing a research report. The rules that are applicable both for quantitative and qualitative research report are as follows :

1. The research report should be presented in a creative, clear, concise and comprehensive style. Literary style of writing is to be replaced by scientific and scholarly style reflecting precise thinking. Descriptions should be free from bias, ambiguity and vagueness. Ideas need to be presented logically and sequentially so that the reader finds no difficulty in reading.
2. The research report should be written in a clear, simple, dignified and straight forward style, sentences should be grammatically correct. Colloquial expressions, such as 'write up' for report and 'put in' for insert should be avoided. Even great ideas are sometimes best explained in simple, short and coherent sentences. Slang, flippant phrases and folksy style should be avoided.
3. Research report is a scientific document but not a novel or treatise. It should not contain any subjective and emotional statements. Instead, it should contain factual and objective statements.
4. Personal pronouns such as I and me, and active voice should be avoided as far as possible. For example, instead of writing I randomly selected 30 subjects, it is advisable to write thirty subjects were selected randomly by the investigator.
5. Sexist language should be replaced by non-sexist language while writing research report. Male or female nouns and pronouns (he and she) should be avoided by using plurals. For example, write children and their parents have been interviewed rather than child and his parents were interviewed.
6. Instead of using titles and first names of the cited authors, last name is needed. For example, instead of writing Professor John Dewey, write Dewey.
7. Constructed forms of modal auxiliaries and abbreviations should be avoided. For example, shouldn't, can't, couldn't should not be used. However, abbreviations can be used to avoid repetition if the same has been spelled out with the abbreviation in parentheses. For example, researcher can write NCERT if he/she has used NCERT in parenthesis in his/her earlier sentences like National, Council of Educational Research and Training (NCERT). There are few exceptions to this rule for well-known abbreviations such as IQ.

8. Use of tense plays an important role in writing a research report. Past tense or present perfect tense is used for review of related literature and description of methodology, procedure results and findings the study, Present tense is appropriate for discussing results and presenting research conclusions and interpretations. Future tense, except in research proposals, is rarely used.
9. Economy of expression is important for writing a research report. Long sentences and long paragraphs should be avoided. Short, simple words are better than long words. It is important that thought units and concepts are ordered coherently to provide a reasonable progression from paragraph to paragraph smoothly.
10. Fractions and numbers which are less than ten should be expressed in words For example, six schools were selected or fifty percent of students were selected.
11. Neither standard statistical formula not computations are given in the research report.
12. Research report should not be written hurriedly. It should be revised many times before publication. Even typed manuscripts require to be thoroughly proofread before final typing.
13. Typing is very important while preparing research report. Use of computer and word processing programme has made the work easy. However, following rules of typography require to be followed.
 - i) All material should be double spaced.
 - ii) A good quality of hand paper 8(1/2), by 11 in size and 13 to 16 pound in weight should be used.
 - iii) Only one side of the sheet is used in typing.
 - iv) The margin should be 1(1/2) inches. All other margins i.e. the top, the bottom and right should be 1 inch.
 - v) Times New Roman or A Oldman Book Style with 12 size front can be used for typing words in English and book titles can be italicized.
 - vi) Direct quotations not over three typewritten lines in length are included in the text and enclosed in quotation marks. Quotations of more than three lines are set off from the text in a double – spaced paragraph and indented five spaces from the left margin without quotation marks. However, original paragraph indentations are retained. Page numbers are given in parentheses at the end of a direct quotation.

Check Your Progress-II

1. State the style in which a research report needs to be written.

6C.3.3 Mechanisms of Writing Dissertation and Thesis:

In reality, the terms dissertation and thesis carry the same meaning. Thesis is an English (UK) term whereas dissertation is an American term. However, in India, the term thesis is used to denote work carried out for Ph.D. degree whereas the term dissertation is used to denote work carried out for M. Ed. and M.Phil. degrees especially in the academic discipline of Education. Both format or outlines stated earlier under format section. Thesis and dissertation should be complete and comprehensive. The main sections of a dissertation and thesis are (i) Preliminary pages, (ii) Main body of the report and (iii) Appendices.

i) Preliminary pages : The Preliminary pages include title page, supervisor's certificate, acknowledgement page, table of contents, list of tables and figures. The title page usually includes the title of the report, the author's name, the degree requirement, the name and location of the college or university according to the degree and the date or year of submission of the report. Name, designation and institutional affiliation of the guide are also written. The title of a dissertation and thesis should clearly state the purpose of the study. The title should be typed in capital letters, should be centred, in an inverted pyramid form and when two or more lines are needed, should be double spaced. An example of the title page is given in the following box –1.

BOX-1

<p>DEVELOPMENT OF SCIENCE CONCEPTS IN HEARING IMPAIRED CHILDREN STUDYING IN SPECIAL SCHOOLS AND INTEGRATED SETTINGS</p> <p>Thesis submitted to the University of</p> <p>Mumbai for the Degree of</p> <p>DOCTOR OF PHILOSOPHY</p> <p>in</p> <p>ARTS (EDUCATION)</p> <p>By</p>
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As per the requirement of some universities and these include certificate of the supervisor under whose guidance or supervision the research work was completed.

Most theses and dissertations include an acknowledgement page. This page permits the researcher to express appreciation of persons who have contributed significantly to the completion of the report. It is acceptable to thank one's own guide or supervisor who helped at each stage of the

research work, teachers, students or principals who provided data for the research and so on. Only these persons who helped significantly for completion of research work should be acknowledged.

The table of contents is an outline of the dissertation or thesis which indicates page on which each major section (chapter) and subsection beings.

The list of tables and figures are given in a separate page that gives number, title of each table and figure and page on which it can be found. Entries listed in the table of contents should be identical to headings and subheadings in the report, and table titles and figures, titles should be the same titles that are given to the actual tables and figures in the main body of the report.

The main body of the report :The main body of the report includes introduction, review of related literature, methodology and procedures, results and discussion, conclusions and recommendations and appendices. The introduction section includes a theoretical framework that introduce the problem, significance of the study both from theoretical and practice points of view, description of the problem, operational definition of the terms, objectives, statement of hypotheses with rationale upon which each hypothesis is based and sometimes delimitations of the study. The problem requires to be stated in interrogative statement or series of questions which answers are to be sought by the researcher through empirical investigation. Abstract terms and variables used in the problem require to be operationally defined.

The problem should be stated that it should aim at finding the relationship between two variables.

The hypotheses related should be supported by the rationale deduced from the previous research studies or experiences with evidences. Hypothesis which is a tentative answer to the research question should be stated concisely and clearly so that it can be tested statistically or logically with evidences. An example of an hypothesis based on the rationale is given in the Box – 2.

Box – 2

Rationale – 1

Cognitive development possess through form successive stages from **Piagian** perspective, namely, sensory – motor, **pre-operational**, concrete operational and formal operational **stages**. Each stage starts with specific age and is characterized by the development of some specific concepts. Hence, development of science concepts is related to age. It is assumed that age plays vital role in the development of concepts. The hypothesis derived from this rationale is:

The delimitation of the study should include such aspects as variables, sample, area or site, ratings tools and techniques to which the study has been delimited.

The second chapter of the main body of the report includes review of literature. In this chapter, the past research works relating to the present study under report should be described and analysed. The description that includes last name of the previous researcher with year of study in parenthesis includes mainly method and findings briefly and precisely. More description of studies and findings has no meaning unless those descriptions and findings are analysed critically to find out research gaps to be bridged by the present study. Therefore, it is required that after description of the previous research work, the research report should contain a critical appraisal to find out significance the study.

The methodology and procedure section includes the description of subjects, tools and instruments, design, procedures. The description of subjects includes a definition and description of population from which sample is selected, description of the method used in selecting sample and size of the sample, the description of population should indicate its size, major characteristics such as age, grade level, ability level and socio-economic status. The method and sampling techniques used for selection of sample requires to be described in detail along with the size of the sample.

The instruments and tools used for investigation require detailed description. The description includes the functions of the instrument, its validity, reliability and searing procedures. If an instrument is developed by the investigator, the descript needs to be more detailed that specifies the procedures followed for developing the tools, steps used for determining validity and reliability, response categories, scoring pattern, norms, if any, and guidelines for interpretations. A copy of the instrument with scoring key and other pertinent information related to the instrument

are generally given in appendix of the dissertation and thesis but not given in the main body of the report.

The description of the design is given in detail. It also includes a rationale for selection of the design.

The results section describes the statistical techniques applied to data with justification, preselected alpha levels and the result of each analysis. Analysis of data is made under subheadings pertaining to each hypothesis. Tables and figures need to present findings (in summary form) of statistical analysis in vertical columns and horizontal rows. Graphs are also given in the main body of the report. Tables and figures enable the reader to comprehend and interpret data quickly. It is advisable to use several tables rather than to use one table that is crowded. Good tables and figures are self – explanatory. Each table should be presented on the same page. Large tables or graphs should be reduced to manuscript page size either by Photostat on some other process of reproduction. The word table or figure is centred between the page margins and typed in capital letters, followed by the table or figure number in Arabic numerals. Tables and figures are numbered continuously but separately for each chapter.. Title of the table and figure is placed in double space below the word table and figure. The title of the table and figure should be brief and clear indicating the nature of table presented. Column headings and row headings of a table should be clearly labeled. If no data is available for a particular cell, indicate the lack by a dash (-), rather than a zero(0).

Each table and figure is followed by description systematically in simple language with statistical or mathematical language in parenthesis. An example in given in Box –3.

Box – 3

TABLE 1

Z-RATIO OF CONSERVATION RESPONSES OF HEARING IMPAIRED CHILDREN IN INTEGRATED EDUCATIONAL SETTING (IED) AND SPECIAL SCHOOLS

Concepts	Conservation of Mass		Conservation of weight		Conservation of volume	
	setting	%	'z' ratio	%	'z' ratio	%
IED Setting		86	0.96	43	0.29	11
Special School		81		41		10

As can be seen in Table 1, 86 per cent hearing impaired children studying in integration settings and 81 per cent hearing impaired children studying in special schools conserved mass. This difference was not significant for the conservation mass. ($z = 0.96$; $p > .05$).

The result emerged should be followed by discussion and interpretation. Each result is discussed in terms of the original hypothesis to which it relates, and in terms of its agreement or disagreement with previous results obtained by other researchers in other studies. Sometimes, researcher uses a separate section titled '**Discussions**' where all the results emerged are explained either individually or joined both at micro level and macro level.

The conclusion and recommendation chapter includes description of the major findings, discussion of the theoretical and practical implications of the findings and recommendations for future research or future action. In this section, a researcher is free to discuss any possible revisions and additions to existing theory and to encourages studies designed to test hypotheses suggested by the results. The researcher may also discuss the implications of findings for educational practical and suggest studies that can be replicated in other settings. The researcher may also suggest further studies to be designed for investing different dimensions of the problem investigated.

The references of bibliography section of the dissertation and thesis consists of lists of all the sources alphabetically by author's last names that were cited in the report. Most of the authors' names were cited in the introduction and review of related literature, sections, Primary sources that are cited in the body of the dissertation and thesis are only included in the references.

Appendices are necessary in thesis and dissertation reports. Appendices include information and data pertinent to the study which are not important to be included in the main body of the report or are too lengthy. Tests, questionnaire, career letters, raw data and data analysis sheet are included in the appendices. Sometimes, subject index that includes important concepts used in the main body of the report. The list of those concepts are given alphabetically with the page on which each can be found. Appendices are named alphabetically followed with short title relating to the theme. (For example, APPENDIX A Non-verbal Text on concept attainment in Biology.)

MECHANISM OF WRITING PAPERS :

Paper includes a research report prepared for publication in a journal or for presentation in seminar and professional meeting. Paper prepared for journal and seminar follows the same mechanism of writing, style and format. The main purpose of a paper is for sharing the ideas emerged with other researchers, which is not possible through dissertation and thesis. The content and format of a paper and a thesis are very similar except that the paper is much shorter. Lengthy thesis or dissertation may once again be prepared of two papers or articles. The research paper follows the format given below.

1. Title
2. Author's name
3. Abstract (About 100 to 120 words)

4. Introduction
5. Method
6. Results
7. Discussion
8. Reference

Writing of the title of a research paper follows the same mechanism it is followed in dissertation and thesis. Below the title, author's name and address is given.

An abstract of the paper consisting of 100 to 120 words, and containing mainly objectives, methods and findings are given before main body of the paper. Other preliminary pages of the dissertation and thesis are not required in the research paper either to be published in a journal or presented in a seminar.

The introduction section of a research paper consists of a brief description of theoretical background, agreements and disagreement of previous researchers on findings related to the topic center report, objective, hypotheses.

The method section deals with sample size and sampling, instruments and tools, design and procedure of collecting data. In dissertation and thesis, detailed description is necessary, whereas, in research paper the same is to be writing very precisely and comprehensively. The author has to exercise judgment in determining which are the critical aspects of the study and which aspects require more in depth description.

The result section of a research paper includes tables and figures including graphs. However, the tables and figures require to be described in the light of the hypothesis for its acceptance and rejection. The findings described should be supported by statistical values and alpha levels with mathematical signs of less than ($<$) or greater than ($>$) etc. in parenthesis. For example, as it can be seen in table 1, high creative and low creative teachers differed significantly on attitude towards class room teaching ($t = 4.24$; $df = 121$; $p < .01$), child centred practices ($t = 2.14$; $df = 131$; $p < .05$), educational process ($t = 3.38$; $df = 131$; $p < .01$) and pupils ($t = 2.87$; $df = 131$; $p < .01$) in favour of high creative teachers as mean attitude towards class room teaching of high creative teachers is greater than their counterparts.

The discussion section is very important in a research paper. Each finding is discussed in the right of its agreement and disagreement with the previous findings followed with justification based on previous theory and existing body of knowledge. In this section, the researchers are free to give their critical judgment for using new dimensions that were emerged out of the study in order to add something new to the existing body of knowledge or for revision and modification of theory. Critical and analytic description is highly essential in discussion.

Lastly, names of authors cited in the paper **are** given in alphabetical orders beginning with first name in the reference.

Check Your Progress-III

1. Explain the mechanisms of writing a dissertation.

6C.4 BIBLIOGRAPHY :

A bibliography is list of all the sources which the researcher actually used for writing a research report. Bibliography and references and sometimes used interchangeably, but both are different from each other. References consist of all documents including books, journal, articles, technical reports, computer programmes and unpublished works that are cited in the main body of a research report. i.e. dissertation, thesis, journal article, seminar paper, etc. References includes mainly primary sources. A bibliography, in contrast, contains everything that is either cited or not cited in the body of the report but are used by the researcher. It includes both primary and secondary sources. The common trend has been to use bibliography in dissertation and thesis, and reference in journal articles and papers.

The American Psychological Association (APA) Publication, Manual, the Chicago Manual of Style and Uniform System of Citation of Harvard Review Association are available that guide a researcher to write bibliography. However, the APA style is widely used to write bibliography in educational research. It provides guidelines for writing different types of sources such as books, journal articles, unpublished dissertation and thesis, unpublished papers presented at the meeting and seminars, unpublished manuscripts, technical reports etc.

Bibliography is arranged in alphabetical order by the last names of the first authors. When no author is given, the first word of the title or sponsoring organisation is used to begin the entry. Each entry in the bibliography starts at the left margin of the page, with subsequent lines double spaced and indented. Extra space is not given between the entries.

Following illustrations provide information for writing different type of entries in the bibliography.

1. Book:

Vaizey, J. (1967). Education in the modern world. New York : McGraw Hill.

2. Book with multiple authors:

Barzun, J. & Graff, H. F. (1977), The modern researcher, New York : Harcourt, Brace, Hovanovich.

3. Book in subsequent edition:

Hallahan, D.P. & Kauffman, J.M. (1982), Exceptional children (2nd ed.), Englewood Cliffs, NJ : Prentice Press.

4. Editor as author:

Mitchell, J. V., Jr (Ed.), (1985). Mental measurement yearbook (9th ed.), Highland Park, NJ : Gryphon Press.

5. No author given:

Prentice–Hall author's guide. (1978), Englewood Cliffs, NJ: Prentice Hall.

6. Corporate or association author

American Psychological Association, (1983), Publication manual (3rd ed.), Washington, DC : Author

7. Part of a series of books:

Terman, L.M. & Oden, M.H. (1947), Genetic studies of genius series : Vol. 4. The gifted child grows up. Stanford, CA : Stanford University Press.

8. Chapter in an edited book:

Kahn, J.V. (1984), Cognitive training and its relationship to the language of profoundly related children. In J.M. Berg (Ed.), Perspectives and progress in mental retardation. Baltimore : University Park, 211 –219.

9. Journal article:

Seltzer, M.M. (1984) Correlates of community opposition to community residences for mentally retarded persons. American Journal of Mental Deficiency, 89, 1 – 8.

10. Magazine article:

Meer, J. (1984, August), Pet theories, Psychology Today, pp. 60 –67.

11. Unpublished paper presented at a meeting:

Schmidt, M., Khan, J.V. & Nucci, L. (1984, May), Moral and social conventional reasoning of trainable mentally retarded adolescents. Paper presented at the annual meeting of the American Association on Mental Deficiency, Minneapolis, MN.

12. Thesis or dissertation (unpublished):

Best, J.W. (1948), An analysis of certain selected factors underlying the choice of teaching as a profession. Unpublished doctoral dissertation, University of Wisconsin, Madison.

13. Unpublished manuscripts:

Kahn, J.V., Jones, C., & Schmidt, M. (1984). Effect of object Preference on sign learnability by severely and profoundly retarded children : A pilot study. Unpublished manuscript, University of Illinois at Chicago.

Kahn, J.V., (1991). Using the Uzgiris and Hunt scales to understand sign usage of children with severe and profound mental retardation, Manuscript submitted for publication.

14. Chapter accepted for publication:

Kahn, J.V. (in press), Predicting adaptive behavior of severely and profoundly mentally retarded children with early cognitive measures. Journal of Mental Deficiency Research

15. Technical report:

Kahn, J.V., (1981) : Training sensory-motor period and language skills with severely retarded children. Chicago, IL : University of Illinois at Chicago. (ERIC Document Reproduction Service, No. ED 204 941).

6C.5 EVALUATION OF RESEARCH REPORT:

Evaluation of a research report is essential to find out major problems and shortcomings. Through a critical analysis, the student may gain some ideas into the nature of research problem, methodology for conducting research, the process by which data are analysed and conclusions are drawn, format of writing research report, style of writing. The following questions are suggested to evaluate each components of research report.

1. The Title and Abstract

- Are the tile and abstract clear and concise?
- Do they promise no more than the study can provide?

2. The problem

- Is the problem stated clearly?
- Is the problem researchable?
- Is background information on a problem presented?
- Is the significance of the problem given?
- Are the variables defined operationally?

3. The Hypothesis

- Are hypotheses testable and stated clearly?
- Are hypotheses based on sound rationale?
- Are assumptions, limitations and delimitations stated?

4. Review of Repeated Literature

- Is it adequately covered?
- Are most of the sources primary?
- Are important findings noted?
- Is it well organised?
- Is the literature given directly relevant to the problem?

- Have the references been critical analysed and the results of studies compared and constructed?
- Is the review well organised?
- Does it conclude with a brief summary and its implications for the problem investigated?

5. Sample

- Are the size and characteristics of the population studied described?
- Is the size of the sample appropriate?
- Is the method of selecting the sample clearly described?

6. Instruments and Tools

- Are data gathering instruments described clearly?
- Are the instruments appropriate for measuring the intended variable?
- Are validity and reliability the instruments **discussed**?
- Are systematic procedure followed if the instrument was developed by one researcher?
- Are administration, searing and interpretation procedures described?

7. Design and Procedure

- Is the design appropriate for testing the hypotheses?
- Are the procedures described in detail?
- Are control procedures described?

8. Results

- Is the statistical method appropriate?
- Is the level of significance given?
- Are tables and figures given?
- Is every hypothesis tested?
- Are the data in each table and figure described clearly?
- Are the results stated clearly?

9. Discussions

- Is each finding discussed?
- Is each finding discussed in term of its agreement and disagreement with previous studies?
- Are generalizations consistent with the results?

10. Conclusions and Recommendations

- Are theoretical and practical implications of the findings discussed?
- Are recommendations for further action made?
- Are recommendations for further research made?

11. Summary

- Is the problem restated?
- Are the number and type of subjects and instruments described?
- Are procedures described?
- Are the major findings and conclusions described?

Check Your Progress-IV

1. What are the criteria of evaluating a research report?

Suggested Readings

Turabian, K. Manual for Writers of Term Papers, Theses, and Dissertations. (7th ed.) Chicago: University of Chicago Press. 2007.

Cardasco, F. and Gatner, E. (1958). Research Report Writing. New York : Barner and Noble.

