Training of Teacher Educators of Western Region on Research Methodology and Quantitative Data Analysis

REPORT

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Programme Coordinator

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NCERT

Regional Institute of Education
(NACC Accredited A+ Institute)
National Council Of Educational Research And Training, New Delhi
(under Ministry of Human Resource Development, Govt. of India)
Shyamla Hills, Bhopal – 462013, Madhya Pradesh, India

ABOUT THE INSTITUTE

Regional Institute of Education (RIE), Bhopal is a constituent unit of National Council of Educational Research and Training (NCERT), an autonomous body under the Ministry of Human Resource Development, Government of India. The institute is committed to deliver quality Teacher Education programme, both pre-service and in-service. Currently, the institute offers two-year M.Ed., two-year B.Ed., for preparing secondary school teachers in Science, Mathematics, English and Social Science. The institute also offers one-year online-cum-contact program in Diploma Course in Guidance and counselling (DCGC). In addition to these courses, the institute's faculties are also guiding the Ph.D. scholars in various subjects. The in-service programmes cater to the professional needs of teachers, teacher-educators and other school functionaries. The institute is affiliated to Barkatullah University, Bhopal for the award of degrees. The Diploma Course in Guidance and Counselling (DCGC) is awarded by NCERT. The institute has a strong team of faculty members who have excellent records in teaching and research. It works closely with the Ministry of Human Resource Development (MHRD) in implementing the various Government of India initiatives in school education. It has a good track record of campus placement for the students and, in the recent years almost 100% placements through the campus recruitment. The institute is accredited by NAAC as A+ graded institute.

The mission of the institute is to strengthen pupils' learning through advocacy and teaching initiatives. The institute is committed to develop competency and create an aura of imparting quality and finesse education to students, and to facilitate their learning and training innovatively with the proper attention to lay the foundation of their brighter career in teaching profession. Details regarding the institute are available in the website: riebhopal.nic.in.


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PREFACE

Research is not always a concept that practitioners, managers and policy makers respect. Too often it is seen as an academic activity conducted by others – to the profession, not with the profession. If education is not based upon research and evidence, then it runs the risk of being based upon one or more of the following:

- Dogma
- Theory
- Ideology
- Convenience
- Prejudice

We have all been to school; we all have views on how and what we were taught. The trouble is that we were taught in an age gone by new theories and technological advances have taken, and are taking, place. Basing our practice solely on our own learning experiences, without reflection, mean education runs the risk of being outdated and not being forward-looking. Theories come and go and any single theory cannot operate in isolation. Learners and learning are complex and success is influenced by a multitude of factors, social backgrounds, family background, personality, age, gender, location etc. Theories needs to be combined, tested and challenged in order to allow us to adapt to suit local and personal environments. Convenience and manageability are important, but the question is whose convenience'? Teachers can occupy and even control pupils, as well as entertain them. But we have to ask if ' learning' takes place. Learning new things and new ways of behaving can be uncomfortable. It is not enough to base teaching and learning around convenience. Research enables all of the above to be challenged. Basing decisions upon evidence is morally sound. Research can help teachers to understand what works and why, what the short and long-term implications are, provide a justification and rationale for decisions and actions, help to build a repertoire to help deal with the unexpected, identify problems, inform improvement and so forth.

Practitioners have to comply to policy, but that does not mean following a prescribed formula. Teachers can adapt it to fit the individual needs of their own pupils.

But teachers are accountable. The public must have faith in the profession – and attitudes to education vary across many social groups - so the performance of teachers can be demonstrated through the publication of research findings.

Teachers project their own personality upon learning experiences. Sometimes this is intuitive and these decisions can either be successful or fail. Research methodologies give teachers the tools to analyse and make informed decisions about their practice.

Research helps teachers to share with colleagues. Too often research looks backwards and there are lessons to learn.

However, what I would prefer is invention and innovation. I'd like to invent new ways of learning The risk is the recirculating old and stale ideas.

Research should be future oriented and designed to benefit learners rather than the researcher themselves. This programme was conceptualized to train the teacher educators of the Western Region of the country on research methodology and the quantitative data analysis.

I am indebted to Prof. Hrushikesh Senapaty, Director, National Council of Educational Research and Training (NCERT), New Delhi for recommending this programme.

Thanks are also due to Prof. A.D.Tiwari, Head, Programme Monitoring Division, NCERT, New Delhi for approving this programme in PAC.

My heartfelt thanks to Prof. Nityannad Pradhan, Principal Regional Institute of Education, NCERT, Bhopal for providing all kind of support to carry out this training programme. In fact, he is the real architect of this programme who stood like a solid rock behind me to complete this programme.

I am very much grateful to Prof. L.K.Tiwari, Head, Department of Extension Education (DEE), RIE, NCERT, Bhopal for providing suggestions time to time to bring qualitative improvement in the programme. Thanks are also due to his administrative staff of the department.

My sincere thanks to Dr. P.K. Tripathy, Librarian RIE, NCERT, Bhopal for providing the library facility to conduct this programme.

Last but not the least, I am thankful to all the Directors of SCERTs of the Western Region for providing the support and deputing the participants for this programme. My special thanks to all the participants who participated whole-hearted ly in this programme.

Coordinator

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TRAINING OF TEACHER EDUCATORS ON RESEARCH METHODOLOGY AND QUANTITATIVE DATA ANALYSIS

Dr. N.C.Ojha, Asst. Professor, RIE, NCERT, Bhopal

Venue: Regional Institute of Education, NCERT, Bhopal Date: 10th – 17th February, 2018

APPROACH PAPER

All out efforts are being made to achieve the goal of "Education for All" in the country. It has many aspects, including access, enrolment, retention, and learning. Teachers in schools face problems in all these areas. Action research is an approach that can empower teachers to overcome problems in all these areas and may prove useful in achieving the above national goal. It is a continuous, dynamic set of process that a teacher follows to improve the educational situation. The teacher does not remain a mere employee, rather she/he gets to know her/his students well, interact with them, observe them and gather information about them. This adds-up to the professional development of teacher. Hence, research in schools has the strength of challenging the quality of the teachers, teaching-learning process, and finally, the total set-up of the schools.

Over the last decades, research has begun to capture the attention of teachers, administrators, and policy makers around the country. Educators at various levels have embraced it as something that makes conducting research a more 'manageable' task brings about results that a more informative and have immediate and direct application. Research, therefore, is defined as "a process where in activities are carried out systematically to find the solution of a problem". It can also be defined as "any systematic enquiry conducted by teachers, administrators, counselors, or others with vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular school operates, how they teach, and how their students learn" (Mills, 2003). Research allows teachers to study their own classrooms, for example; their own instructional methods, their own students, their own assessments; in order to better understand them and be able to improve their quality or effectiveness. It focuses specifically on the unique characteristics of the population with whom a practice is employed or with whom some action must be taken. This, in turn, results in increased utility and effectiveness for the practitioner. Research helps the practitioners in shouldering the responsibility to improve the existing practices and to act as the agent of change through proven research and intervention.

Teachers are the real agent agents of change. They translate the training into actual classroom practices. DIET/CTE faculties play a great role in training the teachers in the country. They prepare the future teachers of the country. Therefore, it is necessary that teachers/DIET/CTE faculties should be trained in conducting the Research of different types as per the requirement of the situation. Taking into consideration these above facts this training programme is being organized.

The objectives of the programme are as under:

- To train the SCERTs/CTEs and DIETs faculty on the basics of the Educational Research.
- To train the teachers of CTEs and DIETs faculty on different types and methods of educational research.
- To train the teachers of CTEs and DIETs faculty in formulating the Research proposal.
- To train Teachers of CTEs and DIETs faculty in developing various tools for collection of data.
- To train the Teachers of CTEs and DIETs faculty in analyzing data by employing different quantitative and qualitative techniques
- To train the Teachers of CTEs and DIETs faculty in developing various tools for collection if data.
- To train the Teachers of CTEs and DIETs faculty in writing the Research report.

CONTENT

- Research in education, meaning, nature, needs, types
- Quantitative, Qualitative and Mixed Model Research (MMR)
- Identification of the problem for research
- Different methods of conducting research
- Preparation of research proposal
- Areas of research in science, mathematics, language and social science education & inclusive education
- Analysis and interpretation of data
- Interpretation of statistical techniques used in the study
- Action research variables, tools and techniques
- Writing of Bibliography

METHODOLOGY

It has been felt that to augment the effectiveness of the present programme, the training materials have developed in-advance in consultation with the faculty members. All the materials to be transacted are proposed to be presented before the participants. Participatory approach, group discussion, group work, question answer, panel discussion, and the activity method will be followed for the training.

OUTCOME

It is expected that the faculties of DIETs, CTEs, IASEs and the SCERTs, after attending the eight-days training programme will not only be able to get involved in the formulation of the research proposal in a more professionally competent manner but will also be able to train the teachers, administrators, counselors, etc. to conduct the action research in an effective manner. They may also be able to publish their research papers in various national and international Journals.

Training of Teacher Educators of Western Region on Research Methodology and Data Analysis

10th – 17th February, 2018

Proceedings

10/02/2018

The day was begun with the inauguration of the training programme. Prof. Nityanand Pradhan, Principal, RIE, RIE, Bhopal inaugurated the programme. The Co-ordinator, Dr. Nitai Charan Ojha, Asst. Professor welcomed all the participants and the guests. Dr. N.C. Ojha narrated the genesis of the workshop and the activities to be conducted in the five days. Prof. Nityanand Pradhan described the need of the training in the research methodology for the teacher educators. He hoped that the participants of this training programme would be benefitted by this. Prof. L.K. Tiwari, Head, Deptt. of Extension Education, RIE, Bhopal assured the participants of all sorts of assistance for their comfortable stay during the programme and hoped that the training would be very successful for the benefit of the trainees. Dr. N.C.Ojha proposed the vote of thanks.

After the inauguration, Dr. N.C. Ojha discussed the introduction to the educational research. He interacted with the participants. The participants asked questions and discussed the matters in detail. Dr. Ojha also highlighted the steps of the research. Prof. Anil Kumar discussed the importance of educational research for the teacher educators.

After the lunch break, Prof. D.N.Sansanwal initiated the discussion on the different types of the educational research. He categoriesd the educational research as per the different bases. He classified that the research can be classified as per the nature of the data and as per the utility. He also categoried the researches as per the use of methods for conducting the research. In discussing the steps of the research, he analysed and each step with the reasoning and the rule for framing the title of the topic of the research. He also described the role of variables in the research. Participants interacted with the resource person and enjoyed the session. The day ended with the interactive session conducted by Prof. Sansanwal.

11/02/2018

The day's work begun with the Reporting of the 1st day Activities. Dr. N.C.Ojha discussed the issues raised by the participants. Then, followed by a lecture of Prof. Sansanwal. He presented his lecture on the identification of the variables and the research problem. He interacted with the participants with so many exercises and problems. The participants enjoyed the session. He discussed along with the formulation of the research problems and the hypotheses. He, in detail, discussed the various resources for the collection of the related literature.

In the post-lunch session, Prof. Ratnamala Arya discussed the Review of Related literature. She discussed the importance of Review of Related literature in various types of researches and the objectives related to it. The participants are asked to conduct the group work for the formulation of objectives taking into consideration the related literature related to their topics of the research. Dr. N.C.Ojha and Prof. Ratnamala Arya acted as facilitator for the different groups. The participants were given the opportunity to ask their queries.

12/02/2018

In the first session, the participants presented the report of the second day. The session was conducted by Dr. N.C.Ojha. Prof Sansanwal, clarified the doubts of the participants raised in the presentation of the report. Prof. Sansanwal, discussed the design of research. He cited many examples of different types of design and their usefulness in the research. The participants actively participated in the discussion. Prof Sansanwal, also, discussed the tools of research. In the last session Prof. Anil Kumar and Dr. N.C.Ojha discussed on the preparation and the validation the research tools. Participants asked many questions and Prof. Anil Kumar answered all those with examples.

13/02/2018

The fourth day session was started with the presentation by the participants on the topics of the previous day. The session was conducted by Dr. N.C.Ojha. Prof. Ratnamala Arya presented the PPT on sample. She discussed the various types of samples and their uses for different kinds of research. She described the techniques and the mode of sampling. Prof. N. Pradhan, Principal, RIE, Bhopal delivered the lecture on Qualitative research. It was session of interest for the participants. They enjoyed the session and asked many questions related to the qualitative research. Prof. Pradhan, answered all the questions by citing many interesting examples. Dr. N.C. Ojha also facilitated discussion. Group activity was conducted by the participants. After lunch, Prof. Anil Kumar discussed on the quantitative data analysis. He started the application of the Descriptive statistics for the analysis of data. He stressed on the formulation of right type of hypotheses of the research. The objectives and the hypotheses together decide the statistical techniques to be used for the analysis of data. In the last session, Dr. N.C.Ojha discussed the application of Inferential Statistics for the treatment of data. He formulated the objectives and their corresponding hypotheses. By citing these hypotheses, he applied the various statistical techniques those are used for the data analysis.

14/02/2018

The day's session begin with the presentation of the reports of the previous day by the participants. Dr. N.C. Ojha facilitated the presentation. After the report presentation and the discussion, Dr. N.C.Ojha made presentation on the use of SPSS for the analysis of data. He demonstrated the steps of entering data in the SPSS data sheet. The participants were instructed to follow the instructions. He explained the concept of coding and the process of assigning codes to the data. In a nutshell, it can be said that he demonstrated the procedure of data entry. Prof. Sansanwal, demonstrated the application of different tests and their calculation through SPSS. The participants enjoyed the practice of SPSS.

15/02/2018 and 16/02/2018

The sixth day's session was started with the presentation by the participants on the topics of the previous day. The session was conducted by Dr. N.C.Ojha. The whole day was devoted for the practice of SPSS and the preparation of data table. The participants practiced the drawing of tables and preparation charts and graphs. As and when they needed explanation, N.C.Ojha and Prof. Sansanwal provided the assistance to them.

17/02/2018

The participants presented the report of the sixth and seventh day. Lots of queries were clarified by Prof. Sansanwal and N.C. Ojha. Dr. Ojha discussed on the writing of the research report. Prof. Sansanwal, discussed the steps of writing the report as well as the

chapterisation of the report. The participants submitted some research proposals to Prof. Sansanwal. Prof. Sansanwal made corrections, wherever needed. In the afternoon, the valedictory session was organized. Prof. I.B. Chughtai, Dean, RIE, Bhopal was the Chief Guest for the session. Prof. L.K.Tiwari, Head Deptt. of Extension Education was the Guest of Honour. The Chief Guest distributed the certificates to the participants. The participants provided feedback for the entire duration of the programme. They hope that such programmes should be organized in RIE, Bhopal on regular basis, as research is one of the core areas in education. Prof Chughtai and Prof L.K.Tiwari expected that the participants would, surely, apply their knowledge in conducting the research. At the end, N.C.Ojha proposed the vote of thanks.

Chapter - 1
Educational Research: Nature and Types

In the history of human civilization, man was encountered with many perplexing problems in making life more comfortable and resolved such problems through a kind of systematic inquiry into phenomena. This tendency of systematic inquiry resulted in rapid advancement in science and technology, wherein the barriers of time and space were conquered. The method that facilitated the scientists for their remarkable achievements is the scientific method. It is necessary to understand the concept of scientific method, as it is the base for any experimental research/action research. Scientific method is a systematic approach to verify ones assumptions emerged out of observation of phenomena. The essential components in the process of scientific method are:

- Observation
- Formulation of assumptions
- Deduction of consequences and
- Verification and proof

Observation: This is the first step in scientific method. There are two types of observations, namely, common and scientific. In scientific observation several doubts and assumptions are formulated, whereas in common observation such doubts would not arise. Though two persons observe a same phenomenon, for one it may be common but for the other it may be scientific. For example, observing an apple falling from a tree is scientific observation for Newton but for others it is common observation. Scientific observation alone can help a researcher to proceed to the second step of scientific method.

Formulation of Assumptions: Scientific observation produces certain doubts. Basing on these doubts one would arrive at some assumptions. These assumptions are called as hypotheses. So all hypotheses are assumptions but vice versa are not true. In Newton's observation, the doubts emerged out are - why had the apple fallen down? Why had it not gone up? These doubts result in formulation of a hypothesis that earth must have some magnetic attraction.

Deduction of Consequences: In the third step, the consequences are deduced. If the assumption were true, what would be the consequences? In the present example, if the hypothesis of Newton is true, then all the objects should have to be subjected to earth's Magnetic attraction and fall down.

Verification and Proof: After deduction of consequences, in the final step of scientific method, one has to verify whether these consequences are really present. Truth or falsity of hypothesis is verified in this step on the basis of presence or absence of consequences respectively. In the current example, it is verified and proved that all objects fall on to earth and the hypothesis is considered to be true. Keeping this process of scientific method in mind let us Now, peep in into the context where experimental research is necessary in education.

Experimental Research

Experiments in education may be carried out in both action research and fundamental research. Action research experiments are generally preferred for classroom problems and experiments in fundamental research are preferred for theoretical problems. Let us confine our discussion only to action research. In day-to-day classroom teaching, teachers may face several problems in bringing out desired changes among learners. In such situations they think about the problem and also about possible solutions. They face difficulty in giving shape to their ideas in terms of well-defined problem. Even if they define the problem correctly, they may not be able to decide the strategy of research, statistical treatment of data and drawing conclusions. On this premise it may not be apt to train them in research methodology, but it is necessary to make them understand the need to systematically practice an idea and test it in a manner that can be appreciated. We cannot expect teachers to undertake a systematic and sophisticated research to solve their classroom problems. Hence teachers are to be acquainted with the process by which they can study their problems scientifically in order to correct their actions and evaluate their decisions. Most of the teachers face problems of various types and complexity relating to their teaching and many of them attempt to do something about these problems. They think of number of ways to overcome such problems and tries out the efficacy of their actions within normal classroom situation. Most of these efforts may involve experimentation at least to some extent. Hence it is necessary to acquaint teachers with the nature of experimental research.

Experimental research involves finding out the functional relationship among phenomena under controlled conditions. The aim of experimental research is to study the cause and effect relationships between two variables. In the process of experimental research an experimenter manipulates or introduces some changes in one variable and observes the consequent changes in the other variable. In fact scientific method is the basis for experimental research. This can be best be understood when both the processes are compared.

Scientific Method	Experimental Research
1. Observation: Scientific observation gives raise to some doubts	1. A question for which the experimenter seeks an answer.
2. Formulation of hypothesis	2. Hypothesis that describes nature of relationship between two variables.
3. Deduction of consequences	3. Measurement and implementation of experiment.
4. Verification and proof	4. Data analysis to verify there is any relationship between the variables.

Characteristics of Experimental Research: The essential characteristics of experimental research are:

- Control
- Manipulation
- Observation

Control: Researcher has to control all relevant variables except the independent variable. In experimental research control plays a very important role. It is not possible to infer the

effects of independent variable without control. In order to understand the concept of control in experimentation, it is necessary to know about two basic laws, on which the experimental research is based.

Law of the Single Variable: This law states that if two situations are equal in all respects except for an independent variable, any change between two situations can, be attributed to the independent variable.

Law of the Significant Variable: This law states that if significant variables are made equal in two situations, any change between the two situations after manipulation of independent variable to; one of the situations can be attributed to the independent variable.

Manipulation: In the process of manipulation, a predetermined set of varied conditions is imposed on the subjects selected for the experiment. The set of varied conditions referred to as independent variable, the experimental variable or the treatment variable.

Observation: The experimenter is supposed to observe the changes that take place in a dependent variable as a result of manipulation of an independent variable.

Steps in Experimental Research

The steps in experimental research are similar to that of scientific method. The important steps in experimental research are:

- Selection of the problem
- Stating the hypotheses
- Preparing experimental plan
- Execution of the experimental plan
- Data analysis

Selection of the problem: The first step of experimental research is selection of problem. Scientific observation leads to certain doubts and these doubts would be formulated into research problems. In classroom researches, teachers' introspection into their own practices is one of the potential sources of locating the classroom problems. After selection of the problem it is to be defined. The variables to be studied should be defined in operational terms. For example, in a problem that intends to study the effect of source materials on the achievement of in history, the variables, namely, source materials and achievement in history, are to be defined operationally. The experimenter has to explain what exactly the meaning of these terms in his/her experiment. Here, source materials are epigraphs, archaeological findings and minutes of various rulers and achievement in history is the achievement test score.

Stating the Hypotheses: The second step of experimental research is stating the hypothesis in terms of the causal link between two variables under study. In the present example, the hypothesis can be stated as, 'use of source material will improve the achievement in history.'

Preparation of Experimental Plan: The third step of experimental research is planning the procedure of experimentation. Following points are to be kept in mind while planning the experiment.

- Identify non- experimental variables and decide the procedure of control
- Select the procedures of collecting evidences
- Select the procedure of experimental treatment
- Prepare time schedule
- Decide the statistical procedures

In the present example, intelligence and interest may be considered as non-experimental variables and one group pre-test post test design may help to control inter-subject differences.

Execution of Experimental Plan: After preparing the plan it is to be meticulously executed. In this, fourth step of experimental research, an experimenter is expected to introduce his/her experimental treatment and administer the tools as per the experimental plan to collect necessary evidences to test the hypothesis.

Data Analysis: The final step of experimental research is analysis of data/evidences. The data obtained should be subjected to statistical treatment using the statistical techniques decided in the experimental plan.

Limitations of Experimental Research

While conducting experimental research, teachers should keep in view the following precautions.

- The experiment should be based on classroom problems or the concerns that are bothering teachers in their practices.
- The results of an experiment conducted on a group under certain conditions cannot be applied to other groups unless the experimental group is representative of a large population.
- The results should not be over generalized.
- The result should be interpreted with utmost caution because it is difficult to the control so many variables.
- The teacher should not reflect her/his personal bias for a particular method or factor during experimentation
- The experiment should be conducted under condition of the school.

Objectives of educational research

The purpose of educational research is to find out answers to research questions through application of scientific method. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as failing into a number of following board groupings:

1. To gain familiarity with a phenomena or to achieve new insights into it (studies with his objective in view are termed as exploratory or formulative research studies)
2. To portray accurately the characteristics of a particular individual, situation or a group (studies with this objective in view are known as descriptive research studies)
3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this objective in view are known as diagnostic research studies)
4. To hypothesis of a casual relationship between variables (studies of such in nature are hypothesis- testing research studies)

Types of Educational Research

Depending on the purpose or the objectives of carrying out a research study, they are classified into three types as follows:

Fundamental or Basic Research: This is usually carried On in a laboratory or some other sterile environment. This type of research, which generally has no immediate or planned application, may late result in further research of an applied nature.

Applied Research: The purpose of this type of research is improving a product or a process - testing theoretical concepts in actual problem situations. This has most of the characteristics of fundamental research, including the use of sampling techniques and the subsequent inference about the target population.

Qualitative research : It is one of the two approaches to research methodology in social sciences. Qualitative research involves an in-depth understanding of human behavior and the reasons that govern human behavior. Unlike quantitative research, qualitative relies on reasons behind various aspects of behavior. Simply put it investigates the **why** and **how** of decision making, as compared to **what, where** and **when** of quantitative research. Hence, the need is for smaller but focused samples rather than large random samples, which qualitative research categorizes data into patterns as the primary basis for organizing and reporting results. Unlike quantitative research, which relies exclusively on the analysis of numerical or quantifiable data, data for qualitative research comes in many media - including text, sound, still and moving images. One way of differentiating Qualitative research from Quantitative research is that largely qualitative research is exploratory, while Quantitative research hopes to be conclusive. However, it may be argued that each reflect a particular discourse, neither being definitively more conclusive or 'true' than each other. Quantitative data is measurable, while Qualitative data cannot be put into a context that can be graphed or displayed as a mathematical term.

Ethnography *(ethnos=people and graphein* = writing) is the genre of writing that presents varying degrees of qualitative and quantitative descriptions of human social phenomena, based on fieldwork. Ethnography presents the results of a holistic research method founded on the idea that a system's properties cannot necessarily be accurately understood independently of each other. The genre has both formal and historical connections to travel writing and colonial office reports. Several academic traditions, in particular the constructivist and relativist paradigms employ ethnographic research as a crucial research method. Many cultural anthropologists consider ethnography the essence of the discipline.

Action Research: It is a process of deep enquiry into one's practices in service of moving towards an envisioned future aligned with values. Action Research is the systematic, reflective, study of one's actions and the effects of these actions in a workplace context. As such, it involves deep inquiry into one's professional action. The researchers examine their work and look for opportunities to improve. As designers and stakeholders, they work with others to propose, a new course of action to help their community improve its work practices. As researchers, they seek evidence from multiple sources to help them analyze reactions to the action taken. They recognize their own view as subjective and seek to develop their understanding of the events from multiple perspectives. The researcher uses data collected to characterize tile forces in ways that can be shared with practitioners. This leads to a reflective phase in which the designer formulates new plans for action during the next cycle. Action Research is a way of learning from and through one's practice by working through a set of reflective stages that helps a person develop a form of "adaptive" expertise. Over time, action researchers develop a deep understanding of how forces interact to create series of complex patterns. Since the forces are always changing, action research is a process of living one's theory into practice.

The researchers both act and seek to learn from the actions taken. The subject of action research is the actions taken, the change, and the theory of change that is held by the persons enacting the change. While the design of action research can originate with an individual social actions taken without the collaborative participation of others are often less effective. To be successful, the action researchers have to plan in such a way as to draw an ever widening group of stakeholders into the arena of action. The goal is to work towards a better understanding of their situation in order to affect a positive personal and social change. This form of research then is an iterative, cyclical process of reflecting on practice, taking an action, reflecting, and taking further action. Therefore, the research takes shape as it is being performed. Better understanding from each cycle points the way to improved actions.

Process of Action Research

LOOK: Look at what causes a disturbance; what teacher is concerned about; what needs to be improved. The concern may be related to classroom teaching, discipline, administration or any situation in the school institution. Once the concern is identified, questions are posed. This helps to focus upon the problem and analyze it. Such questions which ask - why students are not able to understand/learn the concept, what are the reasons for that and how can they be improved their understanding/learning - make up the **research questions**. The concern and research questions serve as the starting point for the action research. Then the research goes through repeated cycles of Planning, Action, Observation and reflection.

PLAN: Evolution of the plan is borne out of the discussions with collaborators, colleagues and others. A review of literature may help in choosing strategies and alternate methods. Expert's opinion or sheer intuition also helps in the evolution and drafting of the plan.

Various alternatives are thought of and critically analyzed. Finally, one or two strategies may be tried. The solution to the problem is hypothesized. The plan should be flexible but well defined feasible and plausible in the existing situation.

ACT: It is deliberate and controlled implementation of the plan. It is a careful and well thought of variation of the existing practice. The plan is carried out step by step.

OBSERVE: When the change is being put to test, there should be clear, elaborate and careful documentation of the effects of the changed practice. The collected data may be qualitative or quantitative. Utmost care and sincerity should be exercised in documenting the evidence, as this provides the basis for reflection.

REFLECT: The scrutiny of the data brings out the efficacy of the changed action. It the research yields positive results, the new procedure catches the interest of the other colleagues, faculty of the other schools and later of the district and the state in ever increasing subsequent circles. On the other hand, if the research has not yielded positive results, alternate strategies can be planned and the cycle of re-plan - act - observe and reflect can be set into action.

VALIDATION: This is done through analyzing the data. Quantitative data need statistical analysis and qualitative data demands requisite procedures to validate it. Reporting the research leads to critical and constructive discussions among the likeminded people.

Case study:

The case study is one of several ways of doing social science research. Rather than using large samples and following a rigid protocol to examine a limited number of variables, case study methods involve an in-depth, longitudinal examination of a single instance or event: a case. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As a result the researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. Case study research means single and multiple case studies can include quantitative evidence, relies on multiple sources of evidence. Case studies should not be confused with qualitative research and they can be based on any mix of quantitative and qualitative evidence.

Different types of case studies

Exploratory case studies: Exploratory case studies condense the case study process: researchers may undertake them before implementing a large-scale investigation. Where considerable uncertainty exists about program operations, goals, and results, exploratory case studies help identify questions, select measurement constructs and develop measures; they also serve to safeguard investment in larger studies.

Critical instance case studies: Critical instance case studies examine one or a few sites for one of two purposes. A very frequent application involves the examination of a situation of unique interest, with little or no interest in generalizability.

Program effects case studies: Program effects case studies can determine the impact of programs and provide inferences about reasons for success or failures. Prospective case studies: In a prospective case study design, the researcher formulates a set of theory based hypotheses in respect to the evolution of an on-going social or cultural process and then tests these hypotheses at a pre-determined follow-up time in the future by comparing these

hypotheses with the observed process outcomes using "pattern matching" or a similar technique.

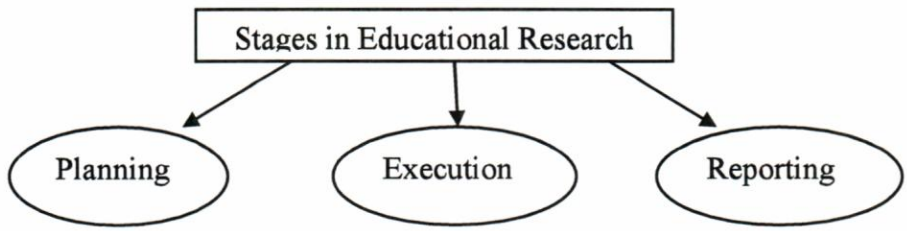
Cumulative case studies: Cumulative case studies aggregate information from several sites collected at different times. The cumulative case study can have a retrospective focus, collecting information across studies done in the past, or a prospective outlook, structuring a series of investigations for different times in the future.

Narrative case studies: Case studies that present findings in a narrative format are called narrative case studies. This involves presenting the case study as events in an unfolding plot with actors and actions.

Embedded case studies: An embedded case study is a case study containing more than one sub-unit of analysis.

Chapter - 2
Steps and Elements of Research

There are basically three stages in educational research, namely, planning, execution and reporting. The first two steps comes under conducting educational research as planning is an integral part in conducting educational research.



Planning: This stage of educational research involves different steps in planning of different elements in preparing the research proposal. The entire edifice of research plan should be built on the research problem. Keeping in view the research problem and review of literature, objectives and methodology will be decided. When once the methodology is finalised, researcher need to spell out work plan, budget and how the results of this research are being utilised. All these elements of educational research yield to a formal normally called as research proposal. Following questions are to be asked while planning educational research.

- What is the problem and why is it to be studied?
- What information is available?
- Why do we want to carry out research? What do we hope to achieve?
- What additional data we require to achieve our research objectives? How are we going to collect this information?
- Who will do what and when?
- What resources do have need to carry out study? What resources do we have?
- How will project be administered? How will utilization of results be ensured?
- How will we present our proposal to relevant authorities/funding agencies?

Planning educational research involved following specific steps.

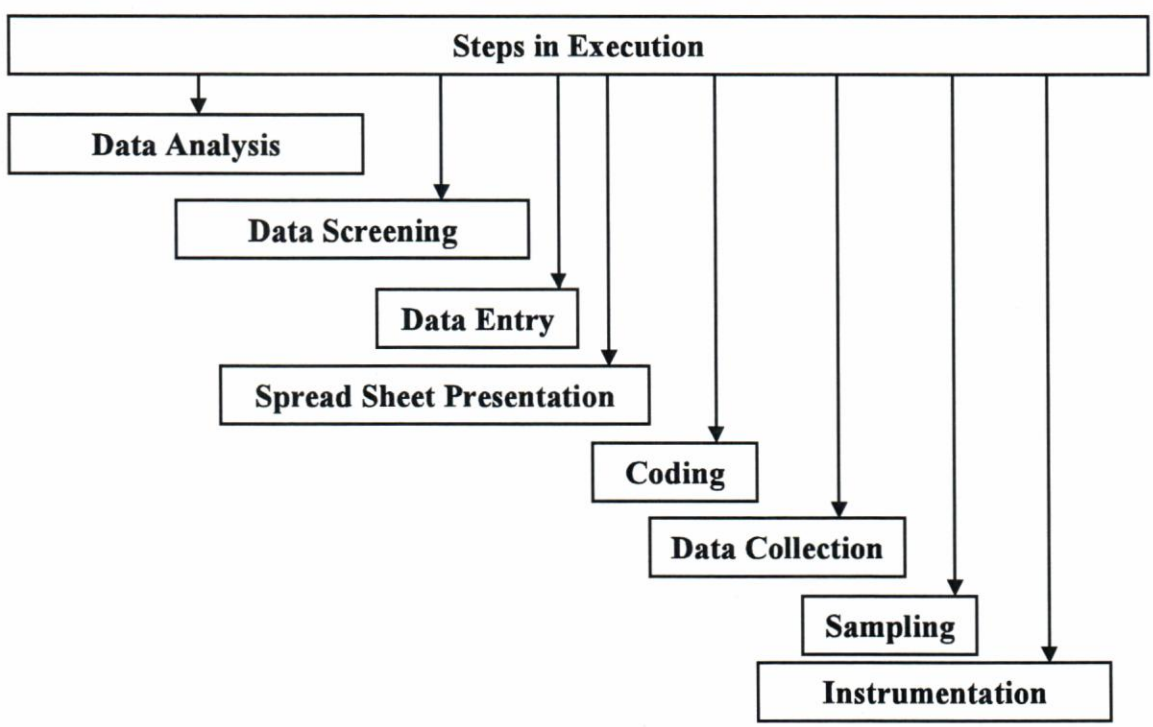
- Selection, analysis and statement of the research problem Literature review
- Formulation of research objectives
- Research Methodology
- Work plan
- Budget
- Plan for project administration and utilization of results
- Proposal summary

Elements in Each Step of Planning:

- Research problem
  - Problem identification
  - Prioritizing problems
  - Analysis
  - Justification

- Literature review
  - Literature
  - Research
  - Other information
- Formulation of research objectives
  - General and specific objectives Hypotheses
- Research Methodology
  - Variables
  - Types of study
  - Data collection techniques Sampling
  - Plan for data collection
  - Plan for data processing and analysis. Ethical consideration
  - Pre-test or pilot study
- Work plan
  - Human resources
  - Time table
- Budget
  - Material support and equipment
  - Finance
- Plan for project administration and utilization of results - Administration
  - Monitoring
  - Identification of potential users
- Proposal summary
  - Briefing sessions
  - Presentations

Execution: This stage of educational research involves different steps of implementing the research plans. It starts from instrumentation and continues up to analysis of data. The detailed steps of this stage of execution of research are instrumentation, sampling, data collection, coding, spread sheets preparation, data entry, data screening and data analysis.



Elements in each Step of Execution:

- Instrumentation

Selection of Techniques
Observation
Interview
Survey

- Selection of Tools

Questionnaires
Rating scales
Checklists
Preparation of Tools
Definition of variables
Identification of behavioral indicators
Preparation of blue print
Preparation of items
Try-out
Item analysis
Reliability
Validity

- Sampling

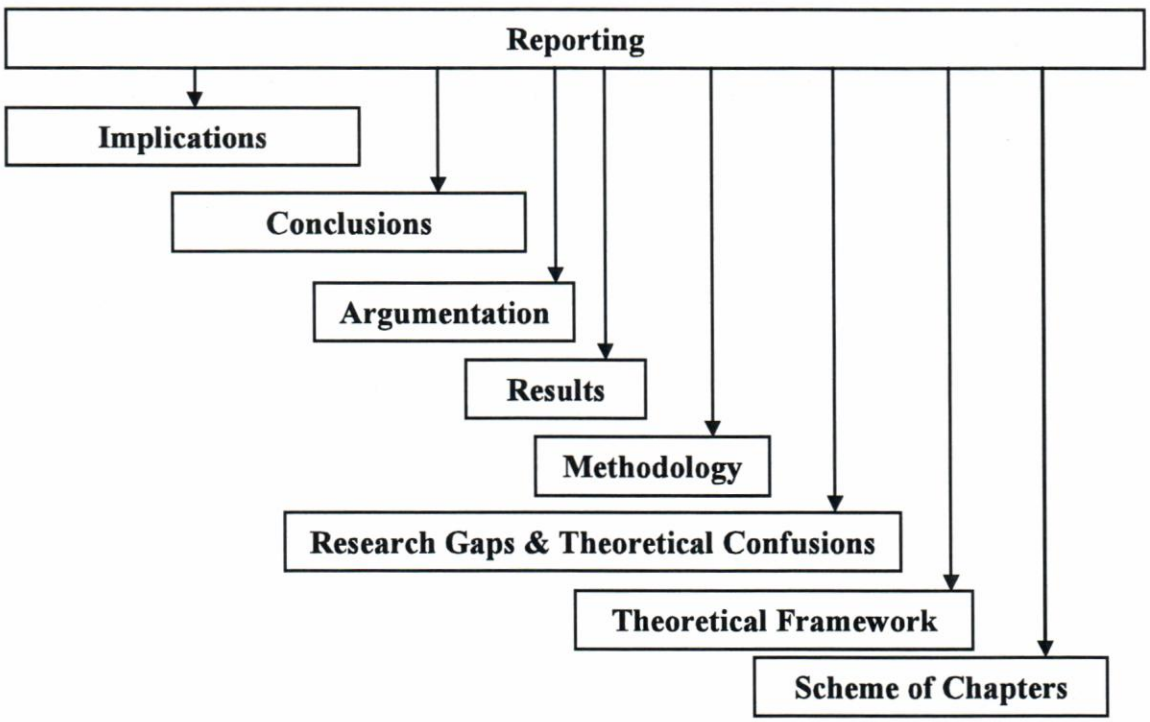
Decide the population
Arrive at different sampling frames
Sources of data
Target groups/Respondents
Quantitative/Qualitative
Define samples
Sampling frames for different sources of data
Decide sampling procedures
Probability/Non-probability
Data Collection
Modes
Online
Telephone
In person
Timing
Duration
Specific context occurrence
Phasing
In one shot
Spacing

- Procedures of transformation of data

Qualitative to Quantitative
Quantitative to Qualitative
Continuous to discrete
Numerical expressions
Ideas to Numbers
Numbers to Ideas

Assigning numbers to categorical variables Triangulation
Symbolizing common ideas from different sources

Reporting: This stage is the most critical in educational research because a researcher would communicate his/her work to different stakeholders. How best the research is being planned and conducted if it is not properly reported, the entire strain a researcher undertook would be futile. This stage starts with scheming chapters to providing varied "implications of the results to different socio-educational contexts. The detailed steps involved in reporting are scheme of chapters, developing a theoretical framework, highlighting the research gaps and theoretical confusions, presentation of methodology, "results, argumentation, conclusions and implications. Care should, be taken in style of reporting and using apt language that could be comprehensible to different audience and stake holders.



Elements in each Step of Reporting:

Scheme of Chapters
Different research reports differ in size and length depending on the type and nature of academic activities that are to be reported
Decide the length of the report
Decide the number of individual chapters
Theoretical Framework
Development of truth claims through objective or subjective evidences/experiences.
Validation of the truth claims
Examine the existing literature in the field
Research Gaps and Theoretical Confusions

Critical Review of Previous Researches
Identification of gaps
Critical Review of Theoretical Literature in the field
Arrive at missing links and confusions
High lighting the points where previous researches failed to answer the theoretical confusions
Methodology
Relating choice of methodology to aims of project/activity
Overall design
Selection of the sample
The process by which data is collected
Data analysis
Statistical analysis
Comparing quantitative and qualitative analysis
Strengths and limitations of methodology
Results
Objectively Reporting Findings
Providing an account of what is found
Balancing the objectivity of results with interpretation
Linking res Lilts to evidences and the claims
Argumentation (Discussion)
Matching results to the introduction in the way it moves - from a close focus to broad
Relating findings to those of other researchers - particularly to the literature reviewed
Strength of the claims with evidences
Establishing a fine sense of the relationship between the strength of a claim (a position or assertion) and the strength of the evidence for that claim
Conclusions
Reaching to a judgment that may go beyond the study to reach a judgment,
Offering some directives
Generating ideas that have been achieved in the study
Implications
Recommendations - proposing an action or further research.
Justifying how the study substantially contributed to the field
Relating the contributions to different socio-educational contexts

Chapter - 3
Characteristics of Good Research

Individual motivation is an essential prerequisite for good academic writing. Most of you write your reports as part of your professional responsibility that is inevitable as a district/state functionary. You may have two contexts that prompts you into report writing - internal or external or both. You may have personal motivation to undertake academic activities and reporting them - this is internal motivation. The external motivation works when your job conditions impose to submit a report. Some times you are compelled to submit reports in short time and notice, where you will be under pressure. This pressure will hamper efficacy of your academic reports. There is often a natural tendency to be thinking continually of completing the report and treat the reporting as a mechanical component of your job compulsion. This makes your reporting endeavor very burdensome task and you may feel that it is an impediment to your personal and professional accomplishments. This is a pity as report writing is a very creative activity. It is an opportunity for you not only to describe your research/academic work. but also to activate your own intellectual capacities. Report writing is not merely an instrumental activity, but an opportunity to express understandings about the outcome of educational endeavors of the state/district. If you can concentrate on this creative dimension to report writing then you will probably enjoy the process much more. The salient features/qualities of report writing are discussed hereunder.

Communication: The main purpose of reporting is to communicate your research experiences to a larger group of academicians. Do not think that it as being written primarily for reporting your academic work. But remember that your report would be of great utility to many other academicians and educational functionaries, This means that through your report you are communicating your ideas, evidences and experiences to a wider range of readers/academicians/educational functionaries at various levels and at different states of our country.

New Perspectives: In the process of report writing, you are helping to lay foundation for future research/academic works. Report writing usually involves reviewing and analyzing the background literature or a subject in which you have conducted an academic work. The purpose of this review is to demonstrate how your academic work is contributing substantially to knowledge. Hence, while reporting your academic work besides transmitting your educational experiences you should provide ne\v perspectives in the field of education.

Friendly to Target Group/Readers: It is necessary that while writing the report keep in mind the target group who would probably read it. A report depicts a complex academic work that you have undel1aken. Your report will be useful only when it is with in the comprehension of the target group/readers. Hence, try to structure your report in such a way that readers are able to navigate their way through it reasonably easily. It should be written in a clear style with minimal use of jargons without compromising to the academic requirements of the subject. It often helps if the report is subdivided into chapters and sections, so that the reader can readily follow the developing argument.

Intellectual Coherence: Before starting to write your report, be sure about the aims of your academic activity. These aims are foundations for your theoretical perspective and

methodology. The overall research design should be appropriate to the aims. For example, if the aims of an academic work are to examine broad trends across a number of different high schools, then the research design will need to use survey techniques, possibly using questionnaires. On the other hand, if the research intends to explore the social context of a group of teachers in a single school then a case study, ethnographic perspective may be more appropriate. Unstructured or semi-structured interviews may be selected as the data collection procedures. In terms of writing the report, it is important to make these connections clear. You should justify how your research design helps in achieving the aims of your academic work. You should maintain a thread of argument running throughout the report. There should be connectivity across the chapters and sections of your report. In brief your report must be coherent.

Judicious Linkage to Literature: Within the report there should be an adequate review or the relevant literature. The literature selected should be sufficiently contemporary to demonstrate the way in which the report is building upon recent research. There will be numerous extracts from different studies and articles. You should be judicious in selecting such literature 'and studies that are quite pertinent to your work. If the previous literature and researchers reviewed are not properly linked to your research work then unnecessarily spoils your main text of the report. Therefore, a balance is to be achieved between the number and length of quotations, and the main text of the report.

Structure: Quality of report depends on the way it is structured. You should structure your report that suits to the nature of your academic work. Depending on the nature of your work, decide the number of chapters and sections. Normal structure followed is - introduction, methodology, results and discussion (IMRAD). In this structure review of literature is included in introduction; conclusions, implications and recommendations are included in discussion. However, you can decide the structure that exactly fits into your academic work. What ever the, structure you choose, referencing should be checked carefully so that details of works cited match in different parts of the report. Consistency is very important in a report. In a good report, there will be consistency in the way the report is written and structured. This applies for example to the spelling of technical terms, to the use of acronyms, and to the way in which subsections are set out and numbered.

Title and Abstract: The report should also have a clear and well-written abstract at the beginning. Many readers in a library will read the abstract before deciding whether or not to read the whole report. The abstract should provide a succinct overview of the whole research project described in the report. It should summarize the context of the research, the aims and research design, the results and the conclusion. Finally, it is the nature of the report. Writing a good title is almost an art form in itself. The title should not be excessively long, but it should describe precisely the nature of the repot and ideally include some of the key words associated with the subject of the research.

Clarity and Precision: Further, report should be clear and precise. Remember that you are writing about fairly complex ideas and these have to be expressed with great precision. In a good report one idea, follows from another in case of presenting-conceptual framework. While presenting analysis of data, report should contain one procedure followed by the other. For example, when analyzing a group of questionnaires, you may first allocate numerical codes to the different alternative responses, and then input the raw data into a statistical analysis package. You may then compute certain statistical tests, and

then' analyze the results. One process tends to follow logically from another, and this should be reflected in the writing about that process. Reporting writing thus tends to proceed very logically and systematically, describing first one process, then explaining how this relates to the next issue, and then describing the second process, Good report makes clear the linkages between the different aspects of the subject being, described or analyzed.

Objectivity: As a very general rule, your report tends to avoid mentioning your personal feelings or attitudes. The emphasis is normally upon considering the research process in a fairly objective manner. It is for this reason, that the traditional approach to academic writing uses the third person singular rather than the first person. However, many interpretative approaches to research, typically using qualitative data, tend to take the view that the researcher 'almost inevitably has an effect upon other research participants during the collection of data. Hence, interpretative researchers often feel that it is permissible, and even desirable, to write at least partially in the first person, in order to explain the particular orientation which they bring to the research process. Such reflexive accounts are often seen, as being a very desirable element in accounts of interpretative research. Thus, as in all genres of writing, one cannot say that conventions are fixed and rigid. It is probably more accurate to see them as evolving, in parallel with developments in never approaches to research.

Justifying Arguments: When writing a report it is normal to include a variety of arguments, inferences, deductions or propositions. These may be based upon an analysis of the relevant literature, an analysis of data which has been collected or, even, upon personal experience. However, it is the norm in academic writing to provide some form of justification for these assertions. A typical justification is to point to previous research and to argue that the new assertion can be seen as reasonable in the light of that. A variant of this type of justification is to make 'references to previous literature on the topic being considered. This literature may include research articles, or perhaps the writing of a noted authority in the field. However, it is perhaps not always a satisfactory justification to rely solely upon a noted authority, without ensuring that those comments or writing are clearly derived from research data. Finally, of course, the writer of a report will typically make assertions based upon the data which has been collected specifically for the purpose of academic activity. Although the appropriate substantiation of assertions is a key feature of academic writing, a related feature is manner in which such assertions are made. The quality of academic writing depends on how assertions and claims to truth are made.

Language Aptness: Language errors may affect the quality of your report. The report should be very carefully proofread, to reduce typographical, punctuation and grammatical errors to a minimum. Though you have substantial evidences to establish your assertions, still you may not be able to affirm truth claims in categorical terms. Hence in a report, it would generally be regarded as more desirable to use phrases such as 'the evidence would appear to suggest that...' or 'one might wish to argue that...' in preference to more definite or affirmative statements. The reason for this approach is ultimately based upon ideas from the philosophy of knowledge. It is generally considered in the social sciences, that it is very difficult to know anything with absolute certainty. No matter how much apparently overwhelming evidence there is for something being true, one can always conceive that in the future, some contrary evidence might appear. Hence, it is suggested to express your claims only to take a tentative position.

Using Specialist Vocabulary: Inevitably academic writings employ a great deal of technical vocabulary. It is quite understandable that a report should contain a number of specialist terms. However, the prime purpose of writing is to communicate, and hence you should be very careful in using highly specialized terms. Essentially, if a specialist term is the correct and widely accepted term for a particular concept, then its use is completely justified. If at all your nature of academic work compels you to use a specific vocabulary, you should heave to provide a working definition of the term. Remember that in your entire report you should use that term in that sense and meaning in which it is defined operationally. The reason why use of many technical jargons are not recommended is that every researcher if they coin a term for their purpose and use it then the problem of having many terms to indicate the same concept or phenomena arises. However, it is important not to stray into the practice of using complicated terms in the hope that they will make the report sound more impressive! If you do this, you are likely to be open to accusations of using jargon.

These, then, are some of the features of academic writing in a report. Of course all these qualities of good report will be discussed step by step in this training programme. Hope that you gain necessary motivation and develop skills of writing a good report.

Chapter-4
Research Problem

Research problem is the foundation on which the entire edifice of research endeavor will have to be built. Quality and standard of any research depends hence on the way how the problem is conceived and defined. Research problem contains the truth claims and ground realities of an educational context. These epistemic and ontological perspectives are the flush and blood of a research problem, as there can't be any meaningful research in the absence of these perspectives. However important or pertinent is the place of research problem in conducting educational research, novice researcher face many problems in ,choosing and defining it due to lack of research experience. Mostly an inexperienced educational researcher would define it broadly and couldn't arrive at exact limits. This problem of defining research problem may also arise due to lack of understanding of nature of educational research and not realizing it as a process of problem-solving. These new and inexperienced researchers often do take it easy and try t6 get a' solution; to ill : defined problem quickly- On the other hand an experienced researcher with their clear understanding of the nature of research, would realize research as a process of searching truth and do realize that it takes time and energy to solve a research problem. They also recognize that solution to a research problem require intensive application of logical thinking.

What is a research problem?

The research problem gives direction. In a conventional sense a problem is a set of conditions needing discussion, a solution, and information. The technical meaning implies .the possibility of empirical investigation, that is, of data collection and analysis. A research problem is not to explain how to do something; it should not be a vague or too broad statement proposition. A research problem is the situation that causes the researcher to feel apprehensive, confused and ill at ease. It is the demarcation of a problem area within a certain context involving the WHO or WHAT, the WHERE, the WHEN and the WHY of the problem situation. Then are many problem situations that may give rise to research. Three sources usually contribute to problem identification. Own experience or the experience of others may be a source of problem supply. A second source could be scientific literature. You may read about certain findings and notice that a certain field was not covered. This could lead to a research problem. Theories could be a third source. Shortcomings in theories could be researched. Research can thus be aimed at clarifying or' substantiating an existing theory, at clarifying contradictory findings, at correcting a faulty methodology, at correcting the inadequate or unsuitable use of statistical techniques, at reconciling conflicting opinions, or at solving existing practical problems.

Identification of Research Problem

The prospective researcher should think on what caused the need to do the research (problem identification). The question that he/she should ask is: Are there questions about this problem to which answers have not been found up to the present?

Research originates from a need that arises. A clear distinction between the PROBLEM and the PURPOSE should be made. The problem is the aspect the researcher worries about, thinks about, and wants to find a solution for. The purpose is to solve the problem,

i.e. find answers to the question(s). If there is no clear problem formulation, the purpose and methods are meaningless. Keep the following in mind:

- Outline the general context of the problem area.
- Highlight key theories, concepts and ideas current in this area.
- What appear to be some of the underlying assumptions of this area?
- Why are these issues identified important?
- What needs to be solved?
- Read round the area (subject) to get to know the background and to identify unanswered questions or controversies, and/or to identify the the most significant issues for further exploration.
- The research problem should be stated in such a way that it would lead to analytical thinking on the part of the researcher with the aim of possible concluding solutions to the stated problem. Research problems can be stated in the form of either questions or statements.
- The research problem should always be formulated grammatically correct and as completely as possible. You should bear in mind the wording (expressions) you use. Avoid meaningless words. There should be no doubt in the mind of the reader what your intentions are.
- Demarcating the research field into manageable parts by dividing the main problem into sub problems is of the utmost importance.

Defining a Research Problem

Defining a research problem is the fuel that drives the scientific process, and is the foundation of any research method and experimental design. It is one of the first statements made in any research. [t is a process of defining the research area and includes a quick synopsis of how the hypotheses were arrived at. While defining the problem it is necessary to define operationally the variables under study and the type of scientific measurements used. This will lead to the proposal of viable hypotheses. Formulating the research problem begins during the first steps of scientific process. As an example, a literature review and a study of previous experiments, and research, might throw up some vague areas of interest. Many scientific researchers look at an area where a previous researcher generated some interesting results, but never followed up. It could be an interesting area of research, which nobody else has fully explored. A scientist may even review a successful experiment, disagree with the results, the tests used, or the methodology, and decide to refine the research process, retesting the hypothesis. This is called the conceptual definition, and is an overall vie\v of the problem. A science report will generally begin with an overview' of the previous research and real-world observations. The researcher will then state how this led defining a problem. Research is a cyclic process that starts with a problem and ends with a solution to the problem. The problem statement is therefore the axis which the whole research revolves around, because it explains in short the aim of the research.

Statement of the Problem

The statement of the problem involves the demarcation and formulation of the problem, i.e. the WHO/WHAT, WHERE, WHEN, WHY. It usually includes the statement of the hypothesis. The research topic or title should be specific and clear. The topic should

indicate the WHO/WHAT, WHEN, WHY, WHERE and HOW clearly. It is the focus of your research. The following factors should guide the selection of a topic/title:

- the feasibility of the research
- the uniqueness of the research
- the scope of the research
- the topicality of the research
- the polyvalence of the research
- the profitability of the research
- the coverage of the researchers daily job
- the theoretical value of the research
- the practical value of the research

Sources of research problems

In order to specify the research problem, there are several sources, wherein: a researcher can select his research problem. They are - experience, theory and literature.

The professional experience of the researcher is a very important source of research problem. As a result of his/her classroom interactions, a researcher would get some new insights into the different ways of effective performance of a given task. As a result of this, he/she would take some decisions about his/her transaction modes. The effectiveness of these transactional modes can be scientifically investigated. For example, a teacher may want to evaluate the efficacy of problem solving method over conventional method in improving learner's achievement in Mathematics.

Educational and behavioral theories are other excellent source of research problem. There are many theories, whose applicability may be investigated in educational and classroom contexts.

Related literature is another important source of research problems. Research reports, research articles, periodicals etc., suggest areas that need research. After reviewing selected researches and literature, a researcher would be able to smell certain gaps and undertake a research study to answer certain research questions.

Sources of classroom research problems

Classroom teaching is not monotonous but a creative activity to initiate desired educational outcomes. Creative and enthusiastic teachers apply their minds, judgments and imagination to make classroom process more meaningful and palatable to the learners. Classroom problems emerge out of reflection by the teacher, wherein, he/her is supposed to take some decisions to resolve them. If teachers identify a gap between their intentions, aspirations, teaching aim and the knowledge or skills or attitudes actually demonstrated by the pupils, then that creates the classroom problem. Problems that teachers encounter in their teaching can be classified under four areas as follows.

- Teaching aims
- Motivating learners
- Learning activities

- Evaluation of learning outcomes

Teaching aim: The basic question that could arise in deciding the aims of teaching are what kind of changes am I trying to bring about in my students? In what way should my students be different after my teaching? And finally, what should be my teaching aim? In the process of answering theses questions teachers would be able to identify some specific problems pertaining to specific classroom context and decide the course of action in their teaching.

Motivating learners: Some other important questions that a teacher should try to answer and decide what to do are what can I do to make my students attentive in my class? What incentives can I use to accelerate learning? How to create interest among my students in the subject I teach? While answering these questions, teachers would solve many motivational issues and make classroom teaching more effective.

Learning activities: Learning activity is anything that a teacher asks their students to do in order to make their learning *more* effective. In this third area, teachers would try to find out answer to question, such as, what could I ask my students to do that will enable best learning?

Evaluation of learning outcomes: The effectiveness of any classroom teaching would best be understood only through evaluation of progress made by learners. Most of the teachers face problems in deciding the evaluation procedures. So every teacher tries to seek answer to question, what techniques and procedures could I use to find out the learning outcomes?

Besides above-mentioned areas, classroom practitioners would face many classroom research contexts as a result of class room problems they encounter. The sources of locating classroom research problems are self-introspection, students, colleagues, parents and community.

- Self introspection: Reflecting on each lesson, making notes and planning for improvement or a different treatment while teaching nest time
- Students: Behavior, performance (Written, oral and practical/project work) and questions/doubts/comments.
- Colleagues: Discussions and comparing notes.
- Parents: Complaints and remarks.
- Community: Conversations

Strategy Material
School
Self Students Colleagues
Parents Community
Behavior
Non-enrolment Drop-out Attainments Participation Awareness
Teacher Student

Evaluation of research problem

After selection/identification of a research problem, it has to be evaluated in terms or applicability of following characteristics.

- Contribution to the body of knowledge in education: The problem should be able to fill in gaps in present knowledge or resolve inconsistencies in previous research.
- Scope for further research: A research problem, besides answering several questions, should generate number of other questions that need further research.
- Research ability: A problem can be researchable only when it is concerned with the relationship between two or more variables that can be defined and measured.
- Novelty: A researcher should select a. problem, which has no been, so far, investigated.
- Suitability to particular researcher: A problem, however good; should be suitable to the abilities of a researcher. The problem should be in an area in which researcher is competent and interested.

Research trends in elementary education

In order to accomplish universal elementary education (UEE), many efforts are initiated in India yielding different results in different pace. India is a vast country with wide range of socio-cultural variations. The literacy rate has risen from 52.21% in 1991 to 64.20% in 1997 according to recent National Sample Survey estimates. Further, 71% villages in India have a primary school and about 23% have an upper primary school as on 1993. Of all the schools beginning from primary to higher/senior secondary levels, 69% are primary schools and 20% are upper primary schools. About 82% of the school age children at the primary level have been enrolled and at the upper primary level about 54% of the school age children are in the school system. In total, about 72% school age children in the age group of 6-14 have enrolled. About 41% of girls in the age group 6-14 years of age, reach grade V, and many of those completing primary school, cannot read and write. On the cap of it, it is also estimated that one in every ten children suffers from some form of disability. You may be aware that education in India is on the concurrent list though major responsibility for school education remains with the state governments. As such central and state governments work in a meaningful partnership for the educational development in the country. Also, local self-government bodies, namely, panchayati raj institutions in rural areas and municipalities in urban areas have been associated with school education.

Access, participation, achievement and contextual nature of DEE

You might be aware of the various efforts that are being made in the country to achieve the goal of universalisation of elementary education in the country. Universalisation of elementary education (UEE) has been accepted as a national goal since 1950. The directive principles of the constitution of India envisage provision of free and compulsory elementary education to all children up to the age of 14 years. The overall goal includes providing free and compulsory education of satisfactory level to all children. The goals of UEE go beyond the concerns of enrollment to participation and retention, and covers provision of education of a satisfactory quality to all children. Some of the objectives of UEE are - universal access, universal retention, improvement of quality of learning, improved quality of school provision, focus on learning outcomes, teacher capacity building and adult education and literacy programmes.

There are two important components of universal access. They are -

- Universal enrolment of all children including girls, disabled children and children belonging to SC and ST communities in primary classes and provision of upper primary education for them
- Provision of non-formal, education for school dropouts, working children and girls who cannot attend formal schools. In recent years considerable progress has been made in terms *of* providing access *to* basic education. The recent surveys indicate that more than 95% population has access *to* primary education within a distance *of* one kilometer.

Equally important is the retention of children in the school. For many reasons, those who have enrolled in primary education drop out of school system before they even complete the primary cycle. The reasons vary from on context to another. This requires to be handled adequately. Several efforts are. being taken to correct this imbalance. Quality improvement is yet another concern before the country. Unless the quality of primary education improves the UEE remains incomplete. This also includes improved quality of school provision. Every school is expected to have certain basic minimum facilities. A systematic exercise has been carried out to determine basic norms for provision of physical, human as well as academic in each school. It is hoped that this would help to improve the situation better. With the above prerequisites, it is imperative that any country expects certain levels of attainment. As you may be aware, the government of India has developed a framework of 'Minimum Level of Learning' to be attained by every child undergoing primary education. This is also expected to facilitate the teachers to assess for themselves the expected levels of achievement of their pupils in turn speaking on their effectiveness.

In order to achieve all above, it is also necessary to empower teachers with providing the needed capacity. The in service training of teachers based on their needs has also remained a goal of UEE. It is heartening to know that this is also being done at different levels. The tele-conferencing mode has also come to us quite handily. You are aware of the programmes of literacy and adult education. The UEE becomes incomplete if adult education and literacy programmes are ignored. The National Literacy Mission (NLM) covers both the adult education and literacy programmes, which has transformed itself into a mass campaign leading towards a people's movement for total literacy. The goal of NLM is to attain full literacy; it also attempts towards providing the functional literacy to the illiterates.' The UEE attempts to cover all children and adults, make them literate, and no one is to be left illiterate. In this direction other new initiatives have also are being linked up.

Sarva Shiksha Abhiyan: its objectives and strategies

To achieve the goal of UEE, the government of India has taken yet another major comprehensive initiative 'Sarva Shiksha Abhiyan' (SSA), which aims at providing useful and relevant elementary education to all children in the 6-14 age by 2010. It's an effort to universalize elementary education by community ownership of the school system. It is a response to the demand for quality basic education all over the country. The SSA is an attempt to provide an opportunity for improving human capabilities to the poorest children, through provision of community owned quality elementary education in a clear

time frame and a sense of urgency. It signifies a national will to provide the resources and the support for UEE. The SSA is a partnership between central and state governments to fulfill the constitutional obligations of free and compulsory education up to the age of 14 years. It is also an effort to recognize the need for improving the performance of the school system in India. It aims at bridging the social and gender gaps, with the active participation of the community in the management of schools. The specific objectives of SSA are -

- All children in school education guarantee scheme, alternate school. Back to school by 2003;
- All children complete five years of primary schooling by 2007;
- All children complete eight years of schooling by 2010;
- Focus on elementary education of satisfactory quality with emphasis on education for life;
- Bridge all gender and social category gaps at primary stage by 2007 and at elementary education level by 2010;
- Universal retention by 2010.

Strategies of SSA: Some of the strategies central to SSA framework and programme include the following:

- Institutional reforms in states: The SSA is based on the premise that the states will have to take the initiative in implementing UEE. The starting point of SSA will be an assessment of various components of school education for their effectiveness, by the states.
- Sustainable financing in partnership with states: It aims at empowering the states to become more self-reliant economically, retaining the partnership status on a long term basis.
- Community ownership of school based interventions through effective decentralization: Community participation in promoting enrolment and retention in elementary education is a salient feature of SSA.
- Institutional capacity building for improvement in quality: It envisages building capacity for pedagogy, classroom observation, continuous evaluation system, research activities etc., at the district levels in partnership between state and central levels.
- Institutional development, infusion of new approaches and adoption of cost effective and efficient methods.
- Community based monitoring with full transparency: It envisages to correlate school level data with community based information from micro planning and surveys. The grants received and all other transactions apart from attendance and performance of pupils will be displayed on a notice board leading to transparence.
- Community based approach to planning with a habitation as a unit of planning: Habitation plans will be the basis of formulating district plans. The involvement of school, cluster and block revels would be critical for the planning exercise. Even if planning is done at cluster or block level in the initial phase, community mobilization through intensive process of micro planning and school mapping will be mandatory under SSA. Besides perspective plan, each district is also expected to popularize investment in a particular financial year based on the resource availability indicated *by* the central/state governments.

- Accountability to community: SSA envisages participation of the community in achieving UEE. This will promote cooperation between teachers and parents as well as accountability and transparency in all educational transaction.
- Mainstreamed gender approach: Education of girls, especially those belonging to the SC/ST will be of the principal concerns in SSA. Special model clusters for women education or any other innovation for girls' education will be funded under the scheme.
- A focus on the educational participation of children from the SC/ST, religious and linguistic minorities etc.: The educational development of children belonging to Scheduled Castes, Scheduled Tribes and Other Backward Castes, educationally backward minorities, is a special objective of the SSA. Any innovative scheme to bring children from these communities will be funded under the SSA.
- Well-established pre-project phase: It has been decided to commence SSA throughout the country with a well-planned pre-project phase. .
- Thrust on quality and making education relevant: SSA aims to make education at elementary level pragmatic and relevant for children by (i) improvement of curriculum, child-centered activities and effective teaching methods. Any activity that contributes to the learning outcomes of children and makes the school 'an attractive place' to learn would be encouraged.
- Recognition of critical role of teacher and focus on the human resource development needs of teachers: Learning process requires effective facilitation. Child-centered and activity based learning require an even more critical contribution of a teacher. The motivation and competence of a teacher would ultimately determine the quality if the learning environment available to a child. SSA recognizes this critical role and advocate a focus on their development needs. Setting up of BRC/CRC, recruitment of qualified teachers, opportunities for teachers development through participation in curriculum talented material development, focus on classroom process and. exposure visits for teachers, are all designed to develop the human resource among teachers. In the context of the above, it is very important to know that in SSA teachers have a vital role to lay in bringing the qualitative improvement of school education.
- Preparation of District Elementary Education plans: Each district will prepare a District Elementary Education Plan reflecting all the investments being made in the elementary education sector. These plans will assess the current state of infrastructure in a district and identify the resource requirements for OEE. There will be a perspective plan and an annual plan. The perspective plan will be drawn up on the basis of broad norms that have been agreed to under the SSA.

Research trends in teacher education

Teacher education programmes aim at providing some pedagogical concepts and principles to the prospective teachers, develop in them certain desirable attitudes, and provide for training in teaching skills. As a matter of fact, the pedagogical concepts and principles of teaching are provided to the prospective teaches in the hope that these will affect their classroom behaviors, rather in the hope that these concepts will be translated into actual teaching behaviors. This had been accomplished in teacher education institutions through apprentice approach. The prospective teachers teach under the supervision of teachers and teacher educators presumed to be equipped with better teaching skills than themselves. They plan lessons, prepare teaching aids, give lessons,

handle classes for various activities, get guidance and supervision from the supervisors, and try to improve their skills of teaching. Did the practice of providing training in skills of teaching indicated above prove to be satisfactory? The evidence appears to be far from satisfactory, if not totally negative. Again, this may be due to the absence of emphasis on effective teaching behaviors and objective tools of observing, recording and analyzing classroom teaching. With the result, systematic definite feedback cannot be provided to the prospective teachers. Despite their grounding in theory and principles of teaching, and despite the guidance they receive from teachers or teacher educators, the prospective teachers fail to translate the theory and principles of teaching into actual teaching performance. There is a lot gap between theory and practice. Jangira (1979) felt that the hypotheses derived from process-product studies and other studies on instruction can be validated only through experiments of this type. There is dearth of this type of studies. The challenge before the educational researchers is to conduct experiments that can fulfill these criteria. The research needs in the education programmes can be summarized as follows -

- Correlation studies involving variety of teaching behavior and pupil outcomes in the three domains of educational objectives into account the hierarchical level of mental processes involved therein.
- Experimental studies attempting to establish cause-effect relationship between teaching behaviors and pupil outcomes.
- Experimental studies identifying the techniques suited to develop among teachers particular type of teaching behaviors.
- Experimental studies linking training with subsequent teaching behaviors, and ultimately with pupil outcomes.

There are three components that are prominent in teacher related research studies. They are presage, process and product. Presage component refers to the training aspect and personality factors (intelligence, ability, aptitudes etc.) of the teachers. The process component refers to the classroom practices (interaction of teachers and pupils, adjustment of the teacher with the given group of students etc.) and the product component refers to the quality of the products i.e. students produced.

PRODUCT

PRESAGE

PRACTICES

COGNITIVE

AFFECTIVE

AFFECTIVE

Mitzel identified four types of research designs to guide the novice researchers, each involving one or the following four types of independent variables:

- Pupil learning outcomes
- Pupil learning experience
- Teacher performance

- Teacher competence

The four types of research are:

- Type L research
- Type P research
- Type C research
- Type T research

In type L research the dependent variable is a kind of pupil learning outcome; the independent variables include pupil learning experience and individual pupil characteristics and the unit of study is the pupil. The purpose of type L research is to discover what types of learning experiences are most affective in producing a specified kind of learning outcome with a pupil possessing certain characteristics.

In type P research, the dependent variable is pupils' learning experience; the independent variables include teacher performance measures and measure of internal context (characteristics of the teacher's class as a group). The unit of study is the teacher. The purpose of type P research is to discover which teaching strategies or models are most effective in providing pupils in a particular type of class with a specified kind of learning experience.

In type C research. the dependent variable is a measure of teacher performance or implementation of a particular strategy - and the independent variables are measures of competencies in the teacher's repertoire and external context variables. The unit of study is the teacher. The purpose of type C research is to discover what competencies what knowledge, skills, and. values - a teacher must possess in order to implement a particular teaching model or strategy in a particular situation.

In type T research, the dependent variable is a specified competency (such as the ability to use one of the models of teaching appropriately); the independent variables are preexisting teacher characteristics and elements in teacher training. The unit of analysis is the student. The purpose of type T research is to find out how to select and train teachers to mastery of the competency under study.

Chapter - 5
Formulation of Objectives

Objectives of a research summarize what is to be achieved by the study. Objectives should be closely related to the statement of the problem. The general objective of a study states what researchers expect to achieve by the study in general terms. It is possible (and advisable) to break down a general objective into smaller, logically connected parts. These are normally referred to as specific objectives. Specific objectives should systematically address the various aspects of the problem as defined under 'Statement of the problem and the key factors that are assumed to influence or cause the problem. They should specify what you will do in your study, where and for what purpose. An objective indicating how the results will be used should be included in every operational study, either as part of the general objective or as a specific objective. The formulation of objectives will help you to:

- Focus the study (narrowing it down to essentials);
- Avoid the collection of data which are not strictly necessary for understanding and solving the problem you have identified; and
- Organize the study in clearly defined parts or phases.
- Develop your research methodology and will help to orient the collection, an analysis, interpretation and utilization of data.

Following points are kept in mind while formulating objectives of your study:

- Cover the different aspects of the problem and its contributing factors in a coherent way and in a logical sequence;
- Are clearly phrased in operational terms, specifying exactly what you are going to do, where, and for what purpose;
- Are realistic considering local conditions;
- Use action verbs that are specific enough to be evaluated, for example, to determine, to compare, to verify, to calculate, to describe, and to establish;
- Avoid the use of vague non-action verbs such as: to appreciate, to understand, or to study.

Chapter - 6
Variable

A variable is an attribute that reflects or expresses some concept or construct. Variable is that which varies from time-to-time, person-to-person and situation-to-situation. It is a distinguishable quality or characteristic that may likely to vary between and within the individuals, situations and institutions. Height is one example of variable that vary within an individual from time to time and between individuals at the same time. A variable does not stand by itself. It is always associated with persons, institutions, events or objects in an educational setting. In educational/action research, a variable stands for a characteristic or property of persons involved in teaching-learning process, educational institutions, classroom practices, teaching learning material and so on.

Persons involved in teaching-learning process are students, teachers, head teachers, school supervisors and parents. Variables pertaining to students are achievement all school subjects, intelligence, interest, motivation, adjustment, creativity etc. Variables pertaining to teachers are - teaching skills, communication, interaction with students, teaching attitude, job satisfaction, motivation to work, performance, teacher effectiveness, experience, qualifications etc. Educational institutions may be of two categories - for preparing children and for preparing teachers. They may function at different levels of schooling - primary, middle, secondary and senior secondary. The variables pertaining to educational institutions are school and institutional climates, physical facilities, locale, school/institution type etc. The variables under classroom practices are - activity based teaching, learner centered, innovative .practices, organizing learning experiences etc, The variables related to teaching learning material are - audiovisual aids, low cost and no cost material, computer assisted learning and teaching etc. Remember that this is not an exhaustive list of variables. There can be any number of variables as very nature of variable is that varies and distinguishable. The list of variables is provided only to realize that a variable does not stand by itself, it is always associated with persons, institutions, events or objects.

Meaning of variable will be meaningful when values are assigned to them. For example - achievement in terms of marks obtained in school subjects, age in terms of years/months, gender categorization as male and female, attitudes as favorable or unfavorable, school type as government and private etc. Thus a variable includes three elements, namely, the reference of the variable, the variable itself, the possible values of the variable. In case of some variables values are expressed in terms of number and in some values are expressed in words/categories. A variable stands for a characteristic or property. The property changes over time and takes on different values. In other words, the value of the variable changes or varies in an individual from time to time, between individuals at the same time, and between the groups.

Educational research involves observing the changes in the characteristics over a time, in measuring or evaluating them and in finding out relationship between them. Teacher as a classroom researcher need to spend considerable time in doing these things.

One of the important functions of the action research is to verify the efficacy of new practice in improving learning or performance. This process of verification mostly carried out through experimentation. Major components of experimentation are observation,

control and manipulation. Variables are the conditions or characteristics that the experimenter manipulates, controls and observes. The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his/her attempt to ascertain their relationship to observed phenomena. The dependent variable is the condition or characteristic that change according to the changes introduced to the independent variable. All the other variables that have a potential to change the dependent variable (independent) are called as **intervening/extraneous variables**. There are, then, three aspects in experimentation. They are - manipulation of independent variable, all the other variables except independent variable are kept constant or controlled and the effect of the manipulation on the dependent variable is observed.

There are two types of independent variables, viz., treatment and organismic or attribute variables. Treatment variables are those factors that the experimenter manipulates. Attribute variables are those characteristics that cannot be altered by the experimenter. Such independent variables are age, sex, caste etc. These variables have already been determined but the experimenter can decide to include them or remove them as variables in the experiment. The attributive variable is also called as categorical variable. When students are classified into groups, the attribute on which the classification is made is called as categorical variable. The simplest type of categorical variable has only two classes and is called as dichotomous variable, e.g., male-female, pass-fail. Categorical variables with three classes are called as dichotomous variables, e.g., government, semi-government and private schools, high, moderate and low achievement. In contrast to these categorical variables, the other variables are numeric variables since one numeric variable can have many numbers as their values - science achievement will have one number for each student in a class. .

A variable, in fact, is anything that varies. They vary from situation to situation and individual to individual. Educational research is interested in variables because in educational research we attempt to understand why and how they vary and to understand in what context they are subjected to vary in intensity. In order to understand such changes in variables, it is necessary to measure and record the changes in these variables under a given context that a researcher is intended to explore. Then the question that bothers a researcher is that how precisely the variables could be measured. If we measure a variable that can have a value anywhere within a range or scale limits, then such variables are called as continuous variables. It is not always possible to measure certain variables by placing a value within a scale limit. In such conditions, a researcher might attempt to assign a specific value within a range or scale. These kinds of variables where a researcher assigns discrete values within a range are called as discrete variables. Sometimes educational researchers assign a value to a variable that signifies a class or category of that variable. Such variables are called as categorical variables.

Thus a variable means all three elements: the reference of the variable, the variable itself, possible values of the variable and actual values obtained/assigned after assessment. In case of some variables like age, height, the fourth element unit also should be stated, for example, height in feet/inchers or in centimeters. Please note another thing regarding the values of the variable: some values are expressed in numbers (numerical variables); some values are expressed in words (categorical variables) with two, three, four or five categories.

Value of variable changes:

A variable stands for a characteristic or property. The property changes over time and takes on different values. In other words, the value of the variable changes or varies:

1. In an individual from one time to another
2. Between individuals at the same time
3. Between the means of groups:
   a) Change in the means of the same group when measured at different times
   b) Change in the means of two or more groups when measured at the same time

Examples:

1) The achievement score of Sudhir in mathematics during January 2005 is 65 and during 2006 it is 75. There is an increase of 10 units in one year in the same individual.

2) Science achievement scores during 2005 of students of class IX in a test with maximum marks 50 are given below.

Students	Marks
A	30
B	27
C	32
D	15
E	40
F	25 and so on

The same test is given on the same day to 40 students of the same class/same group, taught by the same teacher. Yet the variable (science achievenlent) takes on different values in different students.

3) Means of the marks in the above test for two groups, say IX - A and IX - B, are 26 and 30 respectively. If the same test is given to two classes on the same day, the means may differ.

4) Equivalent forms of the same test (science test Form - A as pre-test and science test Form - B as post test) are given to IX class students before and after special instruction of two months duration. We notice three things, the reference of the variable, the variable itself and the value of the variable. After careful observation of the values of the variables, we may notice the change (increase or decrease) in the values of the variable Then question may arise - Why are the values of the variable higher for some students, lower for others? What is the reason/cause for the high mean performance of the class IX B over IX A? Is it because of the better teaching skills/method of the teacher of IX B or because the students are more intelligent or they studied harder? There is no straight answer to these questions pertaining to events which go on in the classrooms. But some answers can be found if educational research is conducted in the proper manner. To conduct research in a systematic manner a proper understanding of variables is required,

Treatment of variables:

Educational researchers are interested in a) observing the changes in the characteristics occurring over time, b) in measuring or evaluating them and c) in finding out relationship

between them. The educational researcher spends a considerable amount of his/her time in doing these three things. But the third is possible only if the first two are done properly.

Classification of variables in educational research:

The following diagram illustrates different types of variables in educational research,

A. Variable --Reference of the Variable
--Name of the Variable
--Value of the Variable (and unit in some cases)

B. Variables -- Independent and Dependent

Fig. 1: Classification of Variables

Does the researcher have choice in selecting the number or classes/categories pertaining to categorical variables? The answer is 'No' in the case of classes in nature/physiology.

For example:
Sex: Male/Female only
Handedness: Right-handed/Left-handed
Result: Pass/Fail (if 'withheld' is included it becomes trichotomous)
Blood Group: A, B, AB, and 0
Region: Rural/Urban/Semi-urban/Tribal
Caste: SC/ST/OBC

The answer is 'yes' in those cases where the researcher is free to exercise his/her choice according to the needs/objectives of his/her research and according to the data which he/she has gathered.

For example:

Socio- Economic Status (SES): Students may be grouped into three categories or four.
A. High, Moderate and Low
B. Very High, High, Moderate and Low

Similarly intelligence level of students: Three or Four categories.
A. High, Moderate and Low
B. Very High, High, Moderate and Low

Options in a questionnaire or in an attitude scale may be classified as follows.
A. Agree, Undecided and Disagree
B. Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree

Responses indicated in 'A' are examples for three - point scale and responses in 'B' are examples for four - point or five - point scale. But while deciding the number of categories the researcher should put forward his/her reasons or the rationale for selecting a particular number and explain the cut-off points used for grouping and the appropriateness of the grouping scheme used by him/her.

Note: In Ex Post Facto (EPF) research, there is no manipulation of the independent variable. Variables like sex, social class and religion have already exerted their influence on persons, they cannot be manipulated. Thus the EPF researcher tries to explore the influence of such variables (IVs) on a particular numerical variable (DY) which he/she measures while controlling other IVs to the extent possible through research design. Several other aspects are common between Experimental Research and EPF research. Hence whatever has been stated regarding Experimental Research should be suitably modified for designing and executing EPF research. Whatever be the type of educational research one is doing, it is necessary to have a clear idea of the variables to be selected, the tools for collecting data regarding variables, the relation between variables and the required analysis.

Variables and Measurement Scales

The numeric variables in behavioral sciences are assumed to measure on interval scale akin to the interval scales used in the physical sciences for measuring length, mass, time, current and physical quantities. But in education field psychology measurement can not be as accurate as in physical sciences. The second scale of measurement is the ordinal scale, where persons are ordered on the basis of a variable. The categorical tables or attribute variables discussed already rare, based on the nominal scale of measurement.

Nominal Scale	→	Categorical Variable
Ordinal Scale	→	Variables with Ordinal Value
Interval Scale	→	Numeric Variables

Thus we have different types of variables based on the scale of measurement used.

1. The numeric variables in behavioral sciences are assumed to measure on interval scale akin to the interval scales used in the physical sciences for measuring length, mass, time, current and physical quantities (in the exact sciences they also use ratio scales with a point for true zero as in the absolute scale of temperature). But when we compare the accuracy of physical measurements, the measurements in education and psychology are crude. The efforts should continue to make more precise tools to measure variables like intelligence, achievement motivation, self - concept and attitude which are abstract intangibles open to diverse meanings and interpretations.

2. The second scale of measurement is the ordinal scale, where persons or objects are ordered on the basis of a variable. Examples: Ten students have written ten poems or made ten paintings. Judges have ranked them 1, 2, 3 ....., etc. up to rank 10 based on some criteria. Here the values of the variable (literary ability or painting ability) are expressed in ordered numbers, so that you know who is the first, the second, the fifth, etc. the relative values of one person's ability with respect to the others. If the interval scale were to be used in this measurement, the intrinsic values for each person could be known and a measure of the worth of his/her ability on a two, point scale (or five point scale whatever used) would be available. But even if it is attempted, such a measurement may be open to questioning (subjectivity and other factors), hence the practice to make a ranking only.

3. The categorical variables or attribute variables discussed already are based on, the nominal scale of measurement - 'nominal' means names, names for each group or category. Thus we give names to classifications of persons based on sex (boys, girls), personality (extravert, introvert), height (tall, short), etc. Thus the third and lowest scale of measurement may also be expressed using adjectival labels like High, Medium, Low or verbal labels like Agree, Disagree, Neutral etc. The classification of variables based on scales of measurement is shown through the following diagram (figure - 2).

Note that from the scores on the 3rd type of scale (interval scale) we can derive the second (B) and first (A) data types, If we have the scores of 60 students on language achievement, it-is possible to give order according to merit. It is also possible to classify them into different categories like good, average and poor. If we have ordinal scale data regarding some persons, it, is possible to derive nominal scale data from them. But, generating/transforming data in the reverse direction that is from A to Band B to C is not possible in most cases.

The Need to Define Variables:

Very few of the variables used in educational research are clear and unambiguous like age (students, teachers), qualifications and teaching experience (teachers), occupation and income (parents) etc. Most of the other variables are not directly observable and measurable, but are constructs or concepts whose presence and magnitude can only be inferred through some sort of measurement. Vagueness and multiple meanings/interpretations creep into discourse when people talk about abstract entities like intelligence, learning, motivation, attitude, anxiety, social adjustment, cognitive ability, creativity, etc. Experts also differ on the meaning/definition which they attach to each of these terms and rightly so because-these variables are not definable objectively as the concepts and ideas in science. If the variables selected for study by the investigator are open to such varied and multiple interpretations, it is his/her duty to select a particular meaning of the variable, use that meaning or definition in his/her research and present the same meaning to the readers. Two kinds of definitions are possible for each variable: (a) conceptual definition or theoretical definition and (b) operational definition.

Conceptual Definition refers to the meaning given to the concept or variable on a theoretical basis by experts and professionals working in that area. There may be several conceptual definitions given by different experts each following a particular line or school of thought. Learning is a classic example of how the S-R psychologists, the gestalt psychologists and the cognitive theorists (each with further sub-groupings) have defined, explained and researched each group in their own way. Similar is the case with intelligence, creativity, problem - solving, personality and other variables with multiple definitions.

Operational Definitions: Best and Kahn (1993, p. 210) have this to say regarding operational definition - In behavioral research, many of the qualities or variables of interest are abstractions and cannot be observed directly. It is necessary to define them in terms of observable facts, from which the existence and amount of the variables are inferred. This operational definition tells what the researcher must do to measure the variable. For example, intelligence is an abstract quality that cannot be observed directly. Intelligence may be defined operationally as scores achieved on a particular intelligence

test. The authors then go on to explain the limitations of operational definitions and the caution to be exercised in their use.

The educational researcher may follow one of the courses of action outlined below (as a suggestion derived from research experience and reflection and not as a dictum or mandate handed down by an authority):

1. (A) He/she may present a conceptual definition or two allied definitions of the variable form a dictionary/encyclopedia of education, or educational research, or evaluation, or curriculum or from the work of an expert in the field. This may be done especially if his/her research variables are open to multiple meanings/interpretations as stated already (conceptual definition).

(B) He/she should also state an operational definition (in close agreement with the theoretical definition) as to how he/she is going to measure/assess the variable.

OR

2. (A) Conceptual definition may be framed in his/her own words under the guide according to commonly accepted/understood meaning - in the case of less controversial variable like socio - economic status (students), locality (school), job - satisfaction (teacher). In such cases elaborate consultation of dictionary of education etc. may not be necessary, though it is welcome and worth doing.

(B) Furnish the operational definition of the variable which will be in agreement with the above - formulated definition.

OR

3. (A) Present only the operational definition of the variable in the case of variables with clear meaning such as achievement in subjects: language (mother tongue, second language), social studies (history, geography), science (as general science or as physics, chemistry, biology), mathematics (arithmetic, algebra, geometry) stating the conceptual definition in such cases may not be necessary.

So, depending on the problem selected for study and the variables involved, the researcher may do anyone of the above or a suitable combination in the matter of defining the variables.

Chapter - 7
Sampling

Sampling is that part of statistical practice concerned with the selection of individual observations intended to yield some knowledge about a population of concern, especially for the purposes of statistical inference. Each observation measures one or more properties (weight, location, etc.) of an observable entity enumerated to distinguish objects or individuals. Survey weights often need to be applied to the data to adjust for the sample design. Results from probability theory and statistical theory are employed to guide practice. In business, sampling is widely used for gathering information about a population.

Process: The sampling process comprises of following stages:

- Defining the population of concern
- Specifying a sampling frame, a set of items or events possible to measure
- Specifying a sampling method for selecting items or events from the frame
- Determining the sample size
- Implementing the sampling plan
- Sampling and data collecting
- Reviewing the sampling process

Population definition: Successful statistical practice is based on focused problem definition. In sampling, this includes defining the population from which our sample is drawn. A population can be defined as including all people or items with the characteristic one wish to understand. Because there is very rarely enough time or money to gather information from everyone or everything in a population, the goal becomes finding a representative sample (or subset) of that population.

Sometimes that which defines a population is obvious. For example, a manufacturer needs to decide whether a batch of material from production is of high enough quality to be released to the customer, or should be sentenced for scrap or rework due to poor quality. In this case, the batch is the population.

Although the population of interest often consists of physical objects, sometimes we need to sample over time, space, or some combination of these dimensions. For instance, an investigation of supermarket staffing could examine checkout line length at various times, or a study on endangered penguins might aim to understand their usage of various hunting grounds over time. For the time dimension, the focus may be on periods or discrete occasions.

Sampling frame: In the most straightforward case, such as the sentencing of a batch of material from production (acceptance sampling by lots), it is possible to identify and measure ever) single item in the population and to include anyone of them in our sample. However, in the more general case this is not possible. There is no way to identify all rats in the set of all rats. Where voting is not compulsory, there is no way to identify which people will actually vote at a forthcoming election (in advance of the election). These imprecise populations are not amenable to sampling in any of the ways below and to which we could apply statistical theory:

As a: remedy, we seek a *sampling frame* which has the property that we can identify every single element and include any in our sample. The most straightforward type of frame is a list of elements of the population (preferably the entire population) with appropriate contact information. For example, in an opinion poll, possible sampling frames include:

- Electoral register
- Telephone directory

Not all frames explicitly list population elements. For example, a street map can be used as "a frame for a door-to-door survey; although it doesn't show individual houses, we can select streets from the map and then visit all houses on those streets. (One advantage of such a frame is that it would include people who have recently moved and are not yet on the list frames discussed above.)

The sampling frame must be representative of the population and this is a question outside the scope of statistical theory demanding the judgment of experts in the particular subject matter being studied. All the above frames omit some people who will vote at the next election and contain some people who will not; some frames will contain multiple records for the same person. People not in the frame have no prospect of being sampled. Statistical theory tells us about the uncertainties in extrapolating from a sample to the frame. In extrapolating from frame to population, its role is motivational and suggestive. To a researcher, however, representative sampling is the only justified procedure for choosing individual objects for use as the basis of generalization, and is therefore usually the only acceptable basis for ascertaining truth.

A frame may also provide additional auxiliary information' about its elements; when this information is related to variables or groups of interest, it may be used to improve survey design. For instance, an electoral register might include name and sex; this information can be used to ensure that a sample taken from that frame covers all demographic categories of interest. (Sometimes the auxiliary information is less explicit; tor 'instance, a telephone number may 'provide some information about location). Having established the frame, there are a number of ways for organizing it to improve efficiency and effectiveness. It's at this stage that the researcher should decide whether the sample is in fact to be the whole .population and would therefore be a census.

Probability and non-probability sampling

Probability sampling scheme is one in which every unit in the population has a chance of being selected in the sample, and this probability can be accurately determined. The combination of these traits makes it possible to produce unbiased estimates of population totals, by weighting sampled units according to their probability of selection. When every element in the population does have the same probability of selection, this is known as an equal probability of selection' (EPS) design. Such designs are also referred to as 'self weighting' because all sampled units are given the same weight. Probability sampling includes: Simple Random Sampling, Systematic Sampling, Stratified Sampling, Probability Proportional to Size Sampling, and Cluster or Multistage Sampling. These various ways of probability sampling have two things in common. They are:

- Every element has a known nonzero probability of being sampled and

- Involves random selection at some point

Non-probability sampling is any sampling method where some elements of the population have no chance of selection (these are sometimes referred to as 'out of coverage'/'under covered'), or where the probability of selection can't be accurately determined, It involves the selection of elements based on assumptions regarding the population of interest, which forms the criteria for selection. Hence, because the selection of elements is nonrandom, non-probability sampling does not allow the estimation of sampling errors. These conditions place limits on how much information a sample can provide about the population, Information about the relationship between sample and population is limited making it difficult to extrapolate from the sample to the population. Non-probability Sampling includes: Accidental Sampling, Quota Sampling and Purposive Sampling. In addition, non-response effects may turn any probability design into a non-probability design if the characteristics of non-response are not well understood, since non-response effectively modifies each element's probability of being sampled.

Sampling methods: Within any of the types of frame identified above, a variety of sampling methods can be employed, individually or in combination, Factors commonly influencing the choice between these designs include:

- Nature and quality of the frame
- Availability of auxiliary information about units on the frame
- Accuracy requirements, and the need to measure accuracy
- Whether detailed analysis of the sample is expected
- Cost/operational concerns

Simple random sampling: In a simple random sample ('SRS') of a given size, all such subsets of the frame are given an equal probability. Each dement of the frame thus has an equal probability of selection: the frame is not subdivided or partitioned, Furthermore, any given pair of elements has the same chance of selection as any other such pair (and similarly for triples, and so on). This minimizes bias and simplifies analysis of results. In particular, the variance between individual results within the sample is a good indicator of variance in the overall population, which makes it relatively easy to estimate the accuracy of results. However, SRS can be vulnerable to sampling error because the randomness of the selection may result in a sample that doesn't reflect the makeup of the population. For instance, a simple random sample of ten people ham a given population will on average produce five men and five women, but any given trial is likely to over represent one sex and under-represent-the other. Systematic and stratified techniques, discussed below, attempt to overcome this problem by using information about the population to choose a more representative sample. SRS may also be cumbersome and tedious when sampling from an unusually large target population. In some cases, investigators are interested in research questions specific; to subgroups of the population. For example, researchers might be interested in examining whether cognitive ability as a predictor of job performance is equally applicable across racial groups. SRS cannot accommodate the needs of researchers in this situation because it does not provide subsamples of the population. Stratified sampling, which is discussed below, addresses this weakness of SRS. Simple random sampling is always an equal probability of selection (EPS) design, but not all EPS designs are simple random sampling.

Systematic sampling: It relies on arranging the target population according to some, ordering scheme and then selecting elements at regular intervals through that ordered list. Systematic sampling involves a random start and then proceeds with .the selection of every k^{th} element from then onwards. In this case, k = population size/sample *size.* It is important that the starting point is not automatically the first in the list, but is instead randomly chosen from within the first to the k^{th} element in the list. A simple example would be to select every 10^{th} name from the telephone directory (an every 10^{th} sample also referred to as 'sampling with a skip of 10). As long as the starting point is randomized, systematic sampling is a type of probability sampling.

It is easy to implement. However, systematic sampling is especially vulnerable to periodicities in the list. If periodicity is present and the period is a multiple or factor of' the interval used, the sample is especially likely to be unrepresentative of the overall population, making the scheme less accurate than simple random sampling. Another drawback of systematic sampling is that even in scenarios where it is more accurate than simple random sampling (SRS), its theoretical properties make it difficult to quantify that accuracy- Systematic sampling is an 'equal probability of selection' CEPS) method because all elements have the same probability of selection. Systematic, sampling can also be adapted to a non-EPS approach;

Stratified sampling: Where the population embraces a number of distinct categories, the frame can be organized by these categories into separate "strata." Each stratum is then sampled as an independent sub-population, out of which individual elements can be randomly selected. There are several potential benefits to stratified sampling.

- Dividing the population into distinct, independent strata can enable researchers to draw inferences about specific subgroups that may be lost in a more generalized random sample.
- Utilizing a stratified sampling method can lead to more efficient statistical estimates (provided that strata are selected based upon relevance to the criterion in question, instead of availability of the samples). It is important to note that even if a stratified sampling approach does not lead to increased statistical efficiency, such a tactic will not result in less efficiency than would simple random sampling provided that each stratum is proportional to the group's size in the population.
- It is sometimes the case that data are more readily available for individual, preexisting strata within a population than for the overall population; in such cases, using a stratified sampling approach may be more convenient than aggregating data across groups (though this may potentially be at odds with the previously noted importance of utilizing criterion-relevant strata).
- Since each stratum is treated as an independent population, different sampling approaches can be applied to different strata, potentially enabling researchers to use the approach best suited (or most cost-effective) for each identified subgroup within the population.
- Focuses on important subpopulations and ignores irrelevant ones.
- Allows use of different sampling techniques for different subpopulations
- Improves the accuracy/efficiency of estimation
- Permits greater balancing of statistical power of tests of differences between strata by sampling equal numbers from strata varying widely in size.

There are however, some potential drawbacks to using stratified sampling.

- Identifying strata and implementing such an approach can increase the cost and complexity of sample selection, as well as leading to increased complexity of population estimates.
- When exat1 1iil1ing multiple criteria, stratifying variables may be related to some, but not to others, further complicating the design, and potentially reducing the utility of the strata.
- In some cases (such as designs with a large number of strata, or those with a specified minimum sample size per group), stratified sampling can potentially require a larger sample than would other methods although in most cases, the required sample size would be no larger than would be required for simple random sampling.
- Requires selection of relevant stratification variables which can be difficult. Is not useful when there are no homogeneous subgroups.
- Can be expensive to implement.

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

- Variability within strata are minimized
- Variability within strata are maximized
- The variables upon which the population is stratified are strongly correlated with the desired dependent variable

Post stratification : Stratification is sometimes introduced after the sampling phase in a process called "post stratification". This approach is typically implemented due to a lack of prior knowledge of an appropriate stratifying variable or when the experimenter lacks the necessary information to create a stratifying variable during the sampling phase. Although the method is susceptible to the pitfalls of post hoc approaches, it can provide several benefits in the right situation. Implementation usually follows a simple random sample. In addition to allowing for stratification on an ancillary variable, post stratification can be used to implement weighting, which can improve the precision of a sample's estimates.

Oversampling: Choice-based sampling is one of the stratified sampling strategies. In choice-based sampling, the data are stratified on the target and a sample is taken from each strata so that the rare target class will be more represented in the sample. The model is then built on this biased sample. The effects of the input variables on the target are often estimated with more precision with the choice-based sample even when a smaller overall sample size is taken compared to a random sample. The results usually must be adjusted to correct for the oversampling.

Probability proportional to size sampling: In some research studies, the researcher may have access to an "auxiliary variable" or "size measure", believed to be correlated to the variable of interest, for each dement in the population. This data can be used to improve accuracy in sample design. One option is to use the auxiliary variable as a basis for stratification, as discussed above. Another option is probability-proportional-to-size

CPPS') sampling, in which the selection probability for each element is set to be proportional to its size measure, up to a maximum of 1. However, this has the drawbacks of variable sample size, and different portions of the population may still be over- or under-represented due to chance variation in selections. To address this problem, PPS may be combined with a systematic approach.

Example: Suppose we have six schools with populations of 150, 180, 200, 220, 260, and 490 students respectively (total 1500 students), and we want to use student population as the basis for a PPS sample of size three. To do this, we could allocate the first school numbers I to 150, the second school 151 to 330 (= 150 + 180), the third school 331 to 530, and so on to the last school (10 II to 1500). We then generate a random start between 1 and 500 (equal to 1500/3) and count through the school populations by multiples of 500. If our random start was 137, we would select the schools which have been allocated numbers 137, 637, and 1137. i.e. the first, fourth, and sixth schools.

The PPS approach can improve accuracy for a given sample sizes by concentrating sample on large elements that have the greatest impact on. population estimates. PPS sampling is commonly used for surveys of businesses, where element size varies greatly and auxiliary information is often available - for instance, a survey attempting to measure the number of guest-nights spent in hotels might use each hotel's number of rooms as an auxiliary variable. In some cases, an older measurement of the variable of interest can be used as an auxiliary variable when attempting to produce more current estimates.

Cluster sampling: Sometimes it is cheaper to 'cluster' the sample in some way e.g. by selecting respondents from certain areas only, or certain time-periods only. (Nearly all samples are in some sense 'clustered' in time - although this is rarely taken into account in the analysis.). Cluster sampling is an example of 'two-stage sampling' or 'multistage sampling': in the first stage a sample of areas is chosen; in the second stage a sample of respondents *within* those areas is selected.

This can reduce travel and other administrative costs. It also means that one does not need a sampling frame listing all elements in the target population. Instead, clusters can be chosen from a cluster-level frame, with an element-level frame created only for the selected clusters. Cluster sampling generally increases the variability of sample estimates above that of simple random sampling, depending on how the clusters differ between themselves, as compared with the within-cluster variation.

Nevertheless, some of the disadvantages of cluster sampling are the reliance of sample estimate precision on the actual clusters chosen. If clusters chosen are biased in a certain way, inferences drawn about population parameters from these sample estimates will be far off from being accurate.

Multistage sampling: Multistage sampling is a complex form of cluster sampling in which two or more levels of units are imbedded one in the other. The first stage consists of constructing the clusters that will be used to sample from. In the second stage, a sample of primary units is randomly selected from each cluster (rather than using all units contained in all selected clusters). In following stages, in each of those selected clusters, additional samples of units are selected, and so on. All ultimate units (individuals, for instance) selected at the last step of this procedure are then surveyed.

This technique, thus, is essentially the process of taking random samples of preceding random samples. It is not as effective as true random sampling, but it probably solves more of the problems inherent to random sampling. Moreover, it is an effective strategy because it banks on multiple randomizations. As such, it is extremely useful.

Multistage sampling is used frequently when a complete list of all members of the population does not exist and is inappropriate. Moreover, by avoiding the use of all sample units in all selected clusters, multistage sampling avoids the large, and perhaps unnecessary, costs associated traditional cluster sampling.

Matched random sampling: A method of assigning participants to groups in which pairs of participants are first matched on some characteristic and then individually assigned randomly to groups . The Procedure for Matched random sampling can be briefed with the following contexts.

- Two samples in which the members are clearly paired, or are matched explicitly by the researcher. For example, IQ measurements or pairs of identical twins.
- Those samples in which the same attribute, or variable, is measured twice on each subject, under different circumstances. Commonly called repeated measures. Examples include the times of a group of athletes for 1500m before and after a week of special training; the milk yields of cows before and after being fed a particular diet.

Quota sampling: In quota sampling, the population is first segmented into mutually exclusive sub-groups, just as in stratified sampling. Then judgment is used to select the subjects or units from each segment based on a specified proportion. For example, an interviewer may be told to sample 200 females and 300 males between the age of 45 and 60. It is this second step which makes the technique one of non-probability sampling. In quota sampling the selection of the sample is non-random. For example interviewers might be tempted to interview those who look most helpful. The problem is that these samples may be biased because not everyone gets a chance of selection. This random element is its greatest weakness and quota versus probability has been a matter of controversy for many years

Convenience sampling: Convenience sampling (sometimes known as grab or opportunity sampling) is a type of non-probability sampling which involves the sample being drawn from that part of the population which is close to hand. That is, a sample population selected because it is readily available and convenient. The researcher using such a sample cannot scientifically make generalizations about the total population from this sample because it would not be representative enough. For example, if the interviewer want to conduct such a survey at a shopping center early in the morning on a given day, the people that he/she could interview would be limited to those given there at that given time, which would not represent the views of other members of society in such an area, if the survey was to be conducted at different times of day and several times per week. This type of sampling is most useful for pilot testing. Several important considerations for researchers using convenience samples include:

- Are there controls within the research design or experiment which can serve to lessen the impact of a non-random, convenience sample whereby ensuring the results will be more representative of the population?
- Is there good reason to believe that a particular convenience sample would or should respond or behave differently than a random sample from the same population?
- Is the question being asked by the research one that can adequately be answered using a convenience sample?

Chapter - 8
Experimental Design

Experimental design is a blueprint within which the experiment is conducted. The major functions of experimental design are to establish conditions for comparisons and help the experimenter to to make meaningful interpretation of the results. In order to accomplish these functions, an experimenter should keep in mind the following criteria in selecting an experimental design.

Appropriateness: The first criterion, in selecting an experimental design is that it should be appropriate for testing the hypotheses of the study. The efficacy of any experimental design rests not on the complexity or simplicity but on appropriateness. Any design that facilitates an experimenter to solve his/her problem on hand is considered to be a right design. Hence the important task of an experimenter is to select a design, which is suitable to meet the needs of the particular problem/concern.

Adequacy of Control: The second criterion is that the design must provide adequate control so that the effects of independent variable can be measured. In order to establish relationship between the variables under study, an experimental design should control the extraneous variables. Randomization is considered to be the best way to control extraneous variables. Hence, a researcher, as far as possible is advice to select a design which utilizes randomization.

Validity of Research Design: The validity of a research design may be assessed through internal and external validity.

Internal validity : Whether the experimental treatment really contributes to a change in the dependent variable is a basic concern coming under the area of internal validity of research. This can be taken care of only by providing adequate control of threats to internal validity such as history, maturation, pre-testing, measuring instruments, statistical regression, differential selection of subjects, experimental mortality and so on.

External validity: The population to which the experimental findings be generalized is a question concerned to external validity. There are two types of external validity, namely, population validity and ecological validity. Population validity is concerned with the identification of population to which the results of an experiment each generalized. Ecological validity is concerned with generalizing experimental effects to other environmental conditions.

Designs in Experimental Research

In experimental research, one variable is manipulated and the effect of this manipulation on a second variable is observed. The variable, which is manipulated, is known as the experimental variable and the manipulation of independent variable is observed, is known as dependent variable. Experimental design helps a researcher to test the hypothesis. There are four important types of experimental design. Anyone of these experimental designs can be selected depending on the nature of the problem/concern.

- Pre-experimental designs

- True experimental designs
- Quasi-experimental designs
- Factorial designs

Pre-experimental Designs

In these designs, the extraneous variables are sometime little controlled or sometimes not at all controlled. There are two such designs listed under this type. They are one group pre-test post-test design and two-group static design (post-test only).

One Group Pre-test Post-test Design: In this design the experimenter conducts pre-test and post-test to measure the dependent variable before and after the manipulation of independent variable respectively. Any difference in pre-test and post-test may be attributed to the independent variable.

Pre-test
Independent Variable
Post-test
Tl
T2

Two Group Static Design (Post-test Only): In this design two groups are used and experimental treatment is provided to one group. The other group, to which the independent variable is not exposed, acts as control group. There is no pre-test in this design. Experimenter assumes that the both the groups are equivalent. Post-test scores, on dependent variable are compared to determine the effect of independent variable.

I	Groups	Independent Variable	Post-test
I	Experimental	X	T
	Control	No X	T

True Experimental Designs

These designs are mostly used in educational research. In these designs, experimenter attempts to control the extraneous variables. There are four types of designs in true experimental designs.

Two Groups, Randomized Subjects, Post-test Design: In this design in order to control extraneous variables, subjects are assigned to two groups through randomization. There is no pre-test and only post-test is administered to measure the dependent variable after exposing experimental group to the independent variable. Control group is not exposed to the independent variable. This design is not practicable for conducting research in school/classroom research.

Groups	Independent Variable	Post-test
Experimental	X	T
Control	No X	T

Two Groups, Randomized Matched Subjects, Post-test Design: In this design subjects are assigned through randomization to both experimental and control groups by using the techniques of matching. Experimental treatment is given to the experimental group. After experimental treatment post-test on dependent variables is given to both the groups.

Groups
Independent Variable
Post -test
Experimental
X T Control
No X

Randomized Groups, Pre-test and Post-test Design: In this design, subjects are assigned' to both experimental and control groups by using random procedures. A pre-test (T1) is administered to measure dependent variable. The independent variable is exposed to experimental group. After experiment, both groups are administered the post-test (T2).

Experimental

Randomized Solomon Three Groups Design: In this design there will be three groups. Subjects are assigned to groups through randomization. This design uses a second control group in addition to experimental and control groups. The second control group is not pre-tested but exposed to independent variable. After the experimental treatment all the three groups are administered a post-test.

Groups	Pre-test	Independent Variable	Post-test
Experimental (E)	T1	X	T2
Control - I (C1)	T1	No X	T2
Control - II (C2)	No T1	X	T2

Randomized Solomon Four Group Design: In this design the subjects are assigned at random to the four groups. Experimental group and one of the control groups are administered pre-test. The other two control groups are not pre-tested. Experimental treatment is given to experimental group and one of the control groups. For two of the control groups, the experimental treatment is not given.

Groups	Pre-test	Independent Variable	Post-test
Experimental (E)	T1	X	T2
Control - I (C1)	T1	No X	T2
Control - II (C2)	No T1	X	T2
Control - III (C3)	No T1	No X	T2

Quasi - Experimental Designs

These designs provide as much control as possible under existing conditions. There are two designs under quasi-experimental designs. They are non - randomized control group pre-test post-test design and rotation group design.

Non - Randomized Control Group, Pre-test Post test Design: Normally in school situations it may not be possible randomize the groups, which may result in dislocation of school schedule. In such situations, the experimenter may use pre - assembled groups and administer a pre-test to both the groups. Pre-test scores are analyzed to show that there is no significant difference between the groups. Then random procedure may be used to decide experimental and control group. Experimental treatment is provided to experimental group and then post-test is administered to both the groups.

Groups	Pre-test	Independent Variable	Post-test
Experimental	T1	X	T2
Control	T1	No X	T2

Rotation Group Design: this is also known as counter balanced design. In this design each group is exposed to the al experimental treatments through replication. The order of this exposure differs for each group but the sequence is usually the same.

Replication	Method-A	Method-B
Unit-I	Group-1	Group-2
Unit-II	Group-2	Group-1

Factorial Designs

In these designs, an experimenter would manipulate several variables simultaneously in order to assess the effect of each variable and the effects due to interaction among the manipulated variables. This design is complex and may not be suitable to a schoolteacher. The effect of one independent variable alone on the dependent variable may not give the full picture when compared to the understanding which emerges as the result of knowing the interaction of one independent variable with the other. Thus the findings from a one variable design may not be very meaningful. But the interaction between the two independent variables occurring while they exert influence on the dependent variable can be found out only through a Factorial Design. In this design, it is possible to find out effect of one II1dependent variable on dependent variable and the effect of another independent variable on the same dependent variable simultaneously and also the influence of second independent variable on the dependent variable is brought under control. The simplest such design is 2x2 or 2 by 2-Factorial Design. A teacher is interested in comparing the effectiveness of Activity Based Teaching versus Cooperative Learning on the achievement of science. If he feels that there may be a differential effect of these methods on different levels of intelligence, then there will be four groups of subjects - two groups under the two treatments and two groups within each of the two levels of intelligence. This is shown in the following diagram.

Both groups are given instruction for a definite period of time. At the end of the experiment the groups are administered a science achievement test. The mean achievement scores of the four groups arc found out and the statistical analysis is carried out.

Chapter - 9
Tools for Collecting Data

In educational research, researcher can use variety of procedures/tools for collecting data to test hypotheses. Depending on the nature of problem, the researcher has to select/prepare suitable tool/procedure that would provide evidence to verify the hypotheses. Hence it is necessary to acquainted educational researchers with different types of procedures/tools to collect evidences. The procedures/tools for collecting evidences are classified as follows.

- Psychological tests
- Inquiry forms
- Observation
- Interview
- Socio-metric techniques

Psychological tests

The most useful tools for collecting evidences are psychological tests. They are designed to measure intelligence, aptitude, creativity, personality traits, interests, attitudes etc. As these tests are objective and standardized, classroom practitioner can use them for collecting evidences. In case standard test is not available to collect specific evidence, classroom practitioner need to prepare a test that could help her/him in collecting required evidence. The simple procedure of preparing tests involve following steps.

- Planning
- Preparation of draft items
- Tryout
- Item analysis
- Final draft

Planning : While developing a test, researcher should firs think of the purpose and the evidences that are required to verify the hypotheses. Plan the length of test, type of test items and method of scoring.

Preparation of draft items: After planning for the test, teacher has to prepare a preliminary draft items. While preparing the draft items he/she has to consult the existing tests in the area. The preliminary draft must have more than double the items required for the test. Items are then edited and carefully worded. These daft items are to be given to experts for their comments.

Tryout: the preliminary draft then is to be administered to a tryout sample responses of subjects are to be scored according to the scoring key.
Item analysis: in order to assess how far each item of the preliminary draft item is able to discriminate between high and low groups, item analysis is to be carried out. Only then the test items, which are able to discriminate between high and low, are retained and remaining items are removed.

Final draft: Final draft consists of those items, which are retained, in the item analysis; this final test would be administered to the sample.

Inquiry Forms

Inquiry forms gather information about phenomena under study. Questionnaires, schedules, checklists, rating scales and opinionnaires/attitude scales are some of the important tools come under this category.

Questionnaire: It consists of questions to obtain necessary information from the students. It is a popular and widely used tool to collect evidences. In a questionnaire, questions may be in closed *or* open form. Following are the guidelines for preparing a questionnaire.

- The objectives of the study should be reflected in the questions.
- Questionnaire should have potential to get required information.
- Language used in the questionnaire should be suitable to the level of students. Questionnaire should ask such questions for which information is available with the students.
- There should be no leading questions in the questionnaire.
- Questions should be arranged in a logical sequence.
- Questionnaire should not be too lengthy
- Questions should be given to experts for assessing their relevance.
- Double-barrelled questions should be avoided.

Schedule: It is a device consisting of a set of questions, which are asked and filled by the researcher in a face-to-face situation.

Checklist: It is a simple device consisting of a list of items relevant to the concern. The students/teacher would indicate the presence or absence of the item by checking 'yes' or 'no' in the space provided against each item.

Rating Scale: It consists of a set of points, which describe varying degree of the dimension of an attribute being observed/measured. There are number of rating techniques, which enable the teacher to ascribe numerical values or ratings to their judgments of behavior. These techniques are - numerical scales, graphical scales, standard scales, rating by cumulative points and forced choice ratings.

Numerical scales: In these scales, a sequence of defined numbers is supplied to the students. They are asked to assign to each item, an appropriate number to indicate their rating.

Graphic scales: In this scale, against each item, a line is provided with a response continuum. The students will provide their judgment on that item by checking one point in this continuum.

Standard scales: In standard scales a set of standard is provided to the students. The standards are usually objects of same kind to be rated with pre-established scale values.

Rating by cumulative points: The unique feature of this type of rating is in the method of scoring. The rating score of an individual is the sum of the weighted or un-weighted points.

Forced choice ratings: In this method the student is asked to say whether an individual has more of one trait than another of a pair.

Guidelines for preparing a rating scale are - clear definition of the trait to be rated, should have a relevant and suitable response continuum and though there is no strict rule on the number of scale divisions to be used, it is advisable to have 5 to 7 point scale.

Opioniannaire or attitude scale: The inquiry form that attempts to assess the attitude or belief of an individual is known as an opinionnaire or attitude scale.

Observation

In the process of observation, teacher observes the happenings in real life situations and records them according to a pre-planned scheme. Proper planning, implementation and recording is necessary for effective observation.

Planning: While planning for observation following factors are to be considered.

- Definition of specific activities to be observed Length of observation
- Scope of observation
- Recording procedures
- Number of observations
- What to observe
- How to observe

Implementation: While observing, teacher should focus the attention on the specific activities to be observed and use appropriate recording procedures.

Recording: It may take place either simultaneously or soon after observation. Teacher should take precaution to minimize the influence of his bias, attitudes and feelings on the observation report. Anecdotes, time sampling method, incident sampling method and diary method may be used in recording. The advantages of observation method are:

- It is an effective way to gather evidences in a particular situation
- Observation is noted and yield reliable data
- Behavior is recorded at the time of its occurrence

The disadvantages of observation are - students may hide his/her behavior when he knows that he/her is being observed and it is also time consuming and at times it is economic.

Interview

The interview is a process in which action researcher would collect necessary information or data from the students in a face-to-face situation. Interviews are classified as 'structured'

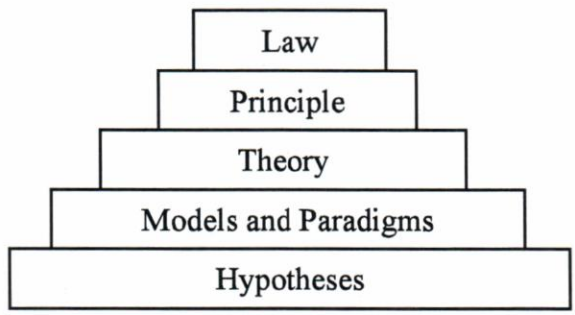
and 'unstructured'. Standardized and pr-determined procedure is followed in structured interview to collect relevant information. Unstructured interview is flexible. Though the procedure and questions to be asked are decided in advance, researcher is free to modify them depending on the situation. The advantage of interview is that, it helps to gather more information. Limitations of interview are that it is time consuming and efficacy mostly depends on the skill of interviewer. It is the only tool by which information can be fathered which is otherwise impossible.

Sociomctric techniques

Sociometric techniques attempt to describe preferences among the members of a group. Some of the important sociometric techniques are - sociogram, sociorpmetric matrices, guess who technique and social distance scales. A classroom practitioner to study the interpersonal relationships of their class may use Sociogram. A sociometric matrix is a rectangular arrangement of numbers indicating the choices of the group members. In guess-who technique, students are asked to read a descriptive statement and asked to write down the name of the student who best fits the description. Social distance scale is another technique to measure social relationship. The advantage of these techniques is that they are easy to administer and interpret. The limitations are information provided is limited by the nature of sociametric questions are individuals do not reveal the reasons why they preferred some members of the group.

Chapter - 10
Hypotheses

Hypothesis is defined as the tentative conclusion for the solution of a problem. It is only a statement that mayor may not be true. Hypothesis is a tentative declarative statement about the relationship between two or more variables. In other words it is an educated guess. Hypotheses are usually based on a theory or model, but it is not uncommon .to see hypotheses that are based simply on the existence of a question that needs to be answered.



The higher levels of the figure represent progressively more abstract and more universal statements. Thus the greater the generalization of the statement, the less it is tentative and subjective. Further more, statements near the bottom are more tentative than those closer to the top.

Meaning of Hypothesis

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 for 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 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.

Importance of Hypothesis

The importance of hypothesis can be more specifically stated as under:

1. It provides direction to research. It defines what is relevant and what is irrelevant.

2. It sensitizes the investigator to certain aspects of the situation, which are relevant from the standpoint of the problem at hand. It spells the difference between precision and haphazardness, between fruitful and fruitless research.
3. It is a guide to the thinking process and the process of discovery.
4. It focuses research.
5. It prevents blind research.
6. It sensitizes the individual to facts and conditions that might otherwise be overlooked.

7. It gives clear and specific foals before us.
8. It serves the function of linking together related facts and information and organizing them into one comprehensible whole.
9. It enables the investigator to understand with greater clarity his/her problem and its ratifications, as well as, the data, which bear on it.
10. It serves as a framework for drawing conclusions.

Sources of Hypothesis

The specific sources of hypothesis are from general culture, form scientific laws or theories, personal experience and analogies.

Characteristics of Good Hypothesis

- The hypothesis should be precise enough to become the solution to a specific problem.
- It can be tested or verified either immediately or eventually.
- Hypothesis is a clear picture of what the end product of the experiment.
- It is logically consistent and free from ambiguity.
- A hypothesis must possess explanatory power.
- The hypothesis should state the expected relationship between variables.

Different Forms of Hypotheses

Hypothesis can be stated in number of forms. They are:

- Null form
- Prediction form
- Declarative form
- Question form

Null Form: It states that no significant difference exists between the variables concerned. For example: There is no significant difference in the instructional standards of single shift and double shift schools. The null form is preferred by most of the experienced research personnel. This form of hypothesis is mostly utilized in the statistically testing the significance. The no difference statement assumes that the two groups will be tested and found to be equal. The experimenter formulates for statistical purpose a null hypothesis, a no difference or relationship between variables.

Prediction Form: It is chosen because it allows the researcher to state principles which he/she actually expects to emerge from the experiment. This type of hypothesis is more useful in action research.

Declarative Form: It generally states a relationship between the variables concerned. For example, we can state that there will be a significant difference in the instructional standards *of* boys and girls schools.

Question Form: The above-mentioned hypothesis in question form may read - Is there a significant difference in the instructional standards of boys and girls schools?

Difficulties in the Formulation of Hypothesis

There are number of difficulties from which a beginner may suffer at the stage of formulating a good hypothesis. They are:

- Lack of knowledge and clarity of the theoretical framework of the area in which the investigator chooses to work.
- Lack of ability to make use the theoretical framework logically.
- Lack of acquaintance with available research techniques resulting failure to phrase the hypothesis properly.

Hypothesis Testing

Most pertinent aspect of any educational research is testing hypotheses. Researchers, depending on their research problem formulates certain hypotheses, may be in any form as discussed above. Almost every researcher encounters certain problems in testing their hypotheses. First and foremost difficulty that a researcher faces is to select appropriate statistical technique to test the hypotheses. Different statistical techniques are discussed under data analysis. Here we shall discuss the general problem of hypothesis testing. This discussion is essential because most of researchers often misinterpret the conclusions of their analysis. There basically two basic concepts that helps us in understanding the hypothesis testing. They are:

- Tests are designed neither to prove nor to disprove hypotheses. Tests are meant for providing us certain kind of information that a researcher may require to tackle his/her research problem. The purpose of research is not to prove anything but to show that an idea is untenable as it leads to an unsatisfactorily small probability.
- In hypothesis testing, what we always try to disprove is that there is no change; for example, there is no difference between the two population means, between the two samples, etc. This is why it is usually referred to as the null hypothesis. H_o.

Clarity in these concepts minimizes our misunderstandings about hypothesis testing. However, it is necessary to keep in mind that some hypotheses are not concerned with such matters. Nave suggested following five steps in the process of hypothesis testing.

Step 1: Formulate the practical problem in terms of hypotheses. This can be difficult in some cases. We should first concentrate on what is called the alternative hypothesis, HI, since this is the more important from the practical point of view. This should express the range of situations that we wish the test to be able to diagnose. In this sense, a positive test can indicate that we should take action of some kind. In fact, a better name for the alternative hypothesis would be the action hypothesis. Once this is fixed it should be obvious whether we carry out a one- or two-tailed test. The null hypothesis needs to be very simple and represents the status quo, i.e. there is no difference between the processes being tested. It is basically a standard or control with which the evidence pointing to the alternative can be compared.

Step 2: Calculate a statistic (T), a function purely of the data. All good test statistics should have following properties:

- They should tend to behave differently when Ho is true from when Hi is true
- Their probability distribution should be calculable under the assumption that H_0 is true
- It is also desirable that tables of this probability distribution should exist.

Step 3: Choose a critical region. We must be able to decide on the kind of values of T which will most strongly point to H I being true rather than Ho being true. Critical regions can be of three types:

- Right-sided, so that we reject I. lo if the test statistic is greater than or equal to some (right) critical value;
- Left-sided, so that we reject H_o if the test statistic is less than or equal to some (left) critical value:
- Both-sided, so that we reject Ho if the test statistic is either greater than or equal to the right critical value or less than or equal to the left critical value.

A value of T tying in a suitably defined critical region will lead us to reject H_0 in favor of HI; if T lies outside the critical region we do not reject Ho. We should never conclude by accepting H_0.

Step 4: Decide the size of the critical region. This involves specifying how great a risk we are prepared to run of coming to an incorrect conclusion we define the significance level or size of the test, which we denote by a, as the risk we are prepared to take in rejecting H_o when it is in fact true. We refer to this as an error of the first type or a Type I error. We usually set α to between I and 10 per cent, depending on the severity of the consequences of making such an error.

We also have to contend with the possibility of not rejecting H_o when it is in fact false and HI is true. This is an error of the second type or Type II error, and the probability of this occurring is denoted by β.

Thus in testing any statistical hypothesis, there are four possible situations which determine whether our decision is correct or in error. These situations are illustrated as follows:

Conclusion	**Situation**	
	H_0 is true	H_0 is false
H_0 is not rejected	Correct Decision	Type II Error
H_0 is rejected	Type I Error	Correct Decision

Step 5: Many textbooks stop after step 4, but it is instructive to consider just where in the critical region the calculated value of T lies. If it lies close to the boundary of the critical region we may say that there is some evidence that Ho should be rejected, whereas if it is

at the other end of the region we would conclude there was considerable evidence. In other words, the actual significance level of T can provide useful information beyond the fact that T lies in the critical region.

In general, the statistical test provides information, from which we can judge the significance of the increase (or decrease) in any result. If our conclusion shows that the increase is not significant then it will be necessary to confirm that the experiment had a fair chance of establishing an increase had there been one present to establish.

In order to do this we generally turn to the power function of the test, which is usually computed before the experiment is performed, so that if it is insufficiently powerful then the design can be changed. The power function is the probability of detecting a genuine increase underlying the observed increase in the result, plotted as a function of the genuine increase, and therefore the experimental design must be chosen 5 that the probability of detecting the increase is high. Also the choice among several possible designs should be made in favor of the experiment with the highest power. For a given experiment testing a specific hypothesis, the power of the test is given by 1 - *B*.

Having discussed the importance of the power function in statistical tests we would now like to introduce the concept of robustness. The term 'robust' denote a statistical procedure which is insensitive to departures from the assumptions underlying, the (TIodel on which it is based. Such procedures are in common lies, and several studies of robustness have been carried out in the field of 'analysis of variance'. The assumptions usually associated with analysis of variance are that the errors in the measurements

I. Are normally distributed.
II. Are statistically independent and
III. Have equal variances.

(Note: For further details on power and robustness, refer to some advanced books On statistics)

Most of the parametric tests are based on the assumption that the populations involved have normal distributions. Therefore a test should only be carried out when the normality assumption is not violated. It is also a necessary part of the test to check the effect of applying these tests when the assumption of normality is violated.

In parametric tests the probability distribution of the test statistic under the null hypothesis can only be calculated by an additional assumption on the frequency distribution of the population. If this assumption is not true then the test loses its validity. However, in some cases the deviation of the assumption has only a minor influence on the statistical test, indicating a robust procedure. A parametric test also offers greater discrimination than the corresponding distribution-free test. For the non-parametric test no assumption has to be made regarding the frequency distribution and therefore one can use estimates for the probability that any observation is greater than a predetermined value.

Chapter 11
Data Analysis

While conducting educational research, on the basis of same observations we analyze type information to draw certain conclusions or inferences. This process consists of three steps. They are observations/measurements (collection of data/information), analysis a (information (data analysis) and drawing conclusions/inferences (statistical estimations). With the help of observations/measurements, we obtain certain information either in ideas or in numerical form. The information that is in the form of ideas is qualitative and that is in numerical form is quantitative. Hence, we may likely to' get either qualitative 0'1' quantitative data. Qualitative data may either be analyzed using qualitative methods or may be converted into quantitative data through transforming the ideas into numbers. Normally, we collect the, information in terms of numerical figures in order to analyze the information. This set of meaningful numerical figures is known as the data. The data, after collection have to be processed and analyzed in accordance with the purpose laid down at the time of developing the research plan. The term analysis refers to the computation of certain measures. Statistics ha two major purposes in the field of educational research. They are - to summarize or simplify the data that have been obtained and to obtain descriptions or arrive at inferences to be made from these data.

Data may be treated in two ways - ungrouped and grouped. When the sample is small we normally analyze the data in ungrouped format and if it is large then the data will be grouped. The statistical data arranged and classified into a number of groups in an orderly manner on the basis of magnitude of the values, constitute a frequency distribution. A table representing them is known as frequency distribution table. Following are the steps involved in preparing a frequency distribution table.

1. Decide the number of class intervals
2. Calculation of range
3. Calculation of class width
4. Determination of lower limits
5. Determination of upper limits
6. Indication of classes
7. Putting the tally marks
8. Obtaining frequencies
9. Indication of final frequency table

Diagrammatic Representation of Data

The data can be represented by means of various types of diagrams, in order to' simplify the complexity of statistical data and to draw the conclusions. The important types of diagrams that could be used to represent data in research report are - bar diagram, pie diagram and histogram. Bar diagram consists of a series of bar with equal width. The bars stand on a common base Line with equal gap between them. The bars may be mostly prepared as they give a better look and facilitate comparison. Bar diagram for following data is prepared.

Class	Number of Students
I	442
II	354
III	288
IV	210
V	163

Pie diagram is a circular diagram. In this type of diagram, a circle is divided into different sectors so as to represent different quantities. Preparation of pie diagram for following data is carried out as an example.

Language	Number of Students
Hindi	123
Marathi	146
Gujarati	87
English	105
Others	24

The angle at the center is 360 degrees and it is to be divided into five parts as follows. Hindi = 123/485x360 = 91.3; Marathi = 146/485x360 = 108.4; Gujarati = 87/485x360 = 64.6; English = 105/485x360 = 77.9; and others = 24/485x360 = 17.8. Five different sectors making angles 91.3, 108.4, 64.6, 77.9 and 17.8 at the center will be used to represent the different language groups as shown below.

In histogram, the data are represented as a series of rectangles. Class intervals are shown on the x-axis and the frequencies on y-axis. A histogram is drawn for the following data.

Class Interval	Frequency
0-20	5
20-40	11
40-60	7
60-80	12
80-100	15

Normal probability curve

Simplest approach to understand normal probability curve is through a consideration of the elementary principles of probability. Probability of a given event is defined as the expected frequency of this event among events of a like sort. This expected frequency of occurrence may be based upon knowledge of the conditions determining the occurrence of the phenomenon, as in dice-throwing or coin-tossing or upon empirical data, as in mental and social measurement. The probability of an event may be stated mathematically as a ratio. This ratio is called as "probability ratio". If we toss one coin, probability of occurrence (Head) is 1/2 and of Non-occurrence (Tail) is 1/2. (H+ T) = 1/2 + 1/2 = 1.00. If we toss two coins, (a) and (b), at the same time, there are four possible arrangements

(I)		(2)		(3)		(4)	
A	b	a	b	a	b	a	b
H	H	H	T	T	H	T	T

$(H + T) = H^2 + 2HT + T^2$ i.e., H^2 is one chance in 4 of 2 heads = 1/4; 2 HT is 2 chances of 1 head & 1 tail = 1/2; and T^2 is 1 chance in 4 of 2 tails = 1/4. The sum of these probability ratios is 1/4 + 1/2 + 1/2 = 1.00. If we toss three coins (a), (b) and (c) then there will be eight outcomes -

$(H+T)^3 = H^3 + 3H^2T + 3HT^2 + T^3$ i.e., H^3 is one chance in 8 of three heads = 1/8; $3H^2T$ is three chances of two heads and one tail = 3/8; $3HT^2$ is three chances of one head and two tails = 3/8; and T^3 is one chance of three tails = 1/8. The sum these probability ratios is 1/8 + 3/8 + 3/8 + 1/8 = 1.00.

If we toss ten coins simultaneously, we get the expression = $(H+T)^{10} = H^{10} + 10H^9T + 45H^8T^2 + 120H^7T^3 + 210H^6T^4 + 252H^5T^5 + 210H^4T^6 + 120H^3T^7 + 45H^2T^8 + 10HT^9T^{10}$. This indicates that there are 1024 outcomes.

H^{10} is one chance in 1024 of ten heads = 1/2014
$10H^9T$ is ten chances of nine heads and one tail = 10/2014
$45H^8T^2$ is forty five chances of eight heads and two tails = 24/1024
$120H^7T^3$ is one hundred and twenty chances of seven heads and three tails = 120/1024
$210H^6T^4$ is two hundred and ten chances of six heads and four tails = 210/1024
$252H^5T^5$ is two hundred and fifty two chances of five heads and five tails = 252/1024
$210H^4T^6$ is two hundred and ten chances of four heads and six tails = 210/1024
$120H^3T^7$ is one hundred and twenty chances of three heads and seven tails = 120/1024
$45H^2T^8$ is forty five chances of two heads and eight tails = 45/1024
$10HT^9T^{10}$ is ten chances of one head and nine tails = 10/1024; and
T^{10} is one chance of ten tails = 1/1024

The sum of these probability ratios is 1/2014 + 10/2014 + 45/2014 + 120/2014 + 210/2014 + 252/2014 + 210/2014 + 120/2014 + 45/2014 + 10/2014 + 1/2014 = 1.00.
Graph plotted on frequency of occurrences and non-occurrences is called as normal probability curve and is shown below.

Measures of Central Tendency

In order to minimize the complexity of data and to make them comparable, it is essential that the various phenomena under study be reduced to one figure each. One of such figures is called measures of central tendency. They give the gist and concise picture of the whole data. There are three measures of central tendency, namely, arithmetic mean, median and mode. A researcher can make use of them in comparing phenomena under investigation.

Arithmetic mean is defined as the ratio of sum of the scores and the total number of scores. The median is the value, which exactly divides the given distribution into two equal halves. Mode is the value, which occurs more frequently. If you want to know the group performance mean is the most useful measure. Some times researcher may like to

know the value that exactly divides the group performance into two equal halves and for this purpose median is the most relevant measure. In order to know the scores that are frequently occurred, mode is the measure that helps a researcher. Mode can be estimated simply by observing the frequencies and this gives crude mode. If you want to know the true mode calculate mean and median, then apply the formula 3 median - 2 mean. Crude mode is an unstable measure of central tendency but this instability is not a serious drawback. Normally for our educational researches crude mode is adequate. Crude mode is a simple and indicates roughly the center of concentration in a given distribution. Mean and median also help to determine the skew ness of the distribution, a measure indicating divergence from normality. The distribution is considered negatively skewed when median is greater than mean and is positively skewed when median is less than mean.

Measures of Dispersion

Measures of dispersion indicate the variability of our scores i.e., scatter or spread of scores around their central tendency specifically arithmetic mean. Some times when you compare two similar types of data, the measure of central tendency may be the same in both cases, but still you find some difference in. them. For example, one set of observation is 3, 5, 7, 11 and 14 and the other set is 8, 8, 8, 8 and 8. The arithmetic means for these two sets of data are same but there is difference in spread of scores. This type of difference is known as the difference in dispersion or variability. Different measures of dispersion are range, quartile deviation, mean deviation and standard deviation. 'Range is the difference between the maximum and the minimum scores of a distribution. Quartile deviation is one-half the scale distance between the 75th and 25th percentiles in a frequency distribution. The 25th percentile is the first quartile (Q 1) and the 75th percentile is third quartile (Q3). Quartile deviation is the average of Q I and Q3. Mean deviation is the mean of the deviations of all the scores separately from their mean. While averaging the deviations ignore the signs i.e., treat all deviations whether plus or minus as positive. Standard deviation is the most stable measure of dispersion and is most frequently used measure of dispersion in educational research.

Statistical Inference

The main purpose of statistical inference is to enable a researcher to generalize from a sample to a population from which the sample is drawn. How can the achievement of students in selected schools of Bhopal city be attributed to all the students in the city? The method of obtaining answer to this involves statistical inference. In any survey type of educational research it is not possible to gather data from entire population and hence educational researchers resort to sampling. But the question comes whether the results obtained from the sample are generalized to a population from which the sample; is Drawn. The means and standard deviations computed from such samples may be larger or smaller than the population values. Here lies the problem of estimating the mean of the population from the sample mean. Means and other measures computed from samples are called 'statistics' and are subject to 'sampling fluctuations'. On the other hand the measures of population are called 'parameters' and are considered as fixed reference values. Parameters of a population are unknown but can be estimated from the sample statistics with a degree of accuracy. The degree to which a sample mean represents its parameter is an index of the 'significance'.

Normally a sample, in order to adequately represent population, should be as large and as randomly drawn as possible. The degree to which a sample mean approximates its parameter depends on the selection of sample. Assuming that a sample is adequately representing the population, resemblance of sample mean to population depends on the number 'of cases and the variability or spread of scores around the mean. Hence the standard error of the mean is the ratio between the standard deviation of the sample and the square root of number of cases in the sample.

SE_M = standard deviation / square root of N

For example in order to estimate the population mean from a sample (N=225) mean of 2726 with standard deviation of 11.2, first it is essential to compute the standard error of mean. In this case the standard error or mean is 0.75. Standard error of mean is considered as the standard deviation of the distribution of sample means (sampling distribution) around the fixed population mean. Sampling distribution centered at the unknown population mean and its standard deviation is 0.75 (SEM). Note that, the sample means fall equally often on the + and - sides of the population mean. About 2/3 of the sample means (68.26%) lie within + or - 1.00 SEM of the population mean, i.e., within a range of + or - 0.75. Further, 95 in 100 sample means lie within + or - 2.00 SEM (more exactly + or - 1.96 SEM) of the population mean - miss the population mean by + or - 1.96 x 0.75 = + or - 1.47.

In the present example the mean of the sample is 27.26. This is one of the sample means represented in the sampling distribution. Hence the expectation is high (the probability is 0.95) that 27.26 will not miss the population mean by more than + or 1.47. Conversely, the probability is low (P = 0.05) that 27.26 does miss the parameter (the population mean) by more than + or - 1.47. Both the statements express the dependability of the sample mean in terms of the degree to which it estimates accurately the population mean.

Transformation of scores

Normally the raw scores are not tenable for comparison as the two numbers may not mean the same. The meaning of the numbers may likely to change as and when the context of measurement changes. In order to make the raw scores comparable, it is necessary to locate their relative positions on a normal curve. This process of converting the scores on normal curve is called as transformation of scores. There are several ways of transforming raw scores to make them comparable. Whatever the way we transform, the underlying principle is that we estimate the distance of a score from the mean on either side of a normal curve. If we convert the score in terms of its deviation from the mean, it is called as a deviation score. This can be obtained by subtracting the score from mean (Deviation score = X-M; where X is the raw score and M is the mean). If this deviation score is divided by the standard deviation of the distribution, it is called sigma score (Sigma Score = X-M/SD). Further, we can transform the raw scores into a corresponding score of a distribution of any expected mean and standard deviation, this kind of transformation gives us the standard score. This is carried out on an assumption that the standard score of a sample is equivalent to the standard score of a population. This can be expressed as follows:

X-M/σ = X-M/σ where X, M, σ are raw score, mean and standard deviation of sample and X, M, σ are corresponding score, mean and standard deviation of population. The corresponding score (X) is the standard score. So we can obtain a standard score with the help of the following formula: X' = 0'/0(X-M) + M'

Correlation

Correlation is relationship between two variables. 1t is one way an expression of agreement between the ordinal positions of two variables. The extern of agreement or disagreement between the variables may vary and this variation indicates the intensity of relationship. There may be three distinct relationship patterns, namely, two variables are in full agreement, indifferent in their agreement and fully in disagreement. These patterns of relationships are called respectively as high positive relationship, indifferent relationship and high negative relationship. For example if we take the scores of five children in mathematics and science, basing on the ordinal positions, three patterns of relationships will be as follows:

Pattern I

Pattern II

Pattern III

Mathematics Science
89 88 87 86 85

Science

Mathematics Science

Mathematics

65 64 63 62 61

8 9

63

88 61 87 65 86. 62 85 64

85

61
86 62 87 63 88 64 89 65

In pattern I, all the connecting lines are horizontal and parallel. Hence, there is one to one correspondence between the variables. We can say that the two variables are in agreement. This type of correlation is called as high positive and perfect. In such patterns of one to one agreement the value of coefficient of correlation will be 1.00.

In pattern II, the connecting lines are not systematic and hence there is no agreement between the variables. This pattern indicates that the relationship is indifferent or low relationship.
In pattern III, all connecting lines intersect in one point. The agreement is in reversal order as student who scored high in mathematics secured low score in science. In a way there is a high relationship but it is negative. The correlation coefficient for such pattern of relationship would be -1.00.

The coefficient of correlation is a ratio between the product of sigma scores of the two variables and the total number of records. This is called as product-moment coefficient of correlation. The reason why it is called as the product-moment is because of thereasol1 that the deviations from the mean (raised to some power) and divided by N is called as 'moment'. When corresponding deviation in x and y are multiplied together, summed, and divided by N ($\Sigma xy/N$) the term 'product-moment' is used. Normally we use this product-moment correlation when our sample is a probability sample, otherwise we would use rank-order correlation. Product-moment correlation coefficient is denoted as 'r' and rank order correlation as 'ρ' (Rho). The coefficient of correlation is a ratio that expresses the extent change in one variable is associated/dependent upon changes in a second variable.

Incase when we take the measures of variables in two different units; sum of the xy will vary. But when deviations are expressed as sigma scores,- the sum of their products (x/σ_x X y/σ_y) divided by N will be same. The quotient $r = \Sigma(x/\sigma_x \text{ X } y/\sigma_y)/N$ is a measure of relationship. On, simplification of this quotient we get the basic formula for coefficient of correlation. Hence, formula for 'r' will be as follows:

$$r = \Sigma xy/N\sigma_x \sigma_y$$

(This is the formula for .coefficient of correlation when deviations are taken from the means of the two distributions)

Significance of difference between means

In educational research, sometimes, we may have to compare the educational performance of two categories of students, such as, caste, locale, gender etc. This would help in estimating whether there is any difference between these categories in terms of their educational performance. In order to estimate such differences in performance, we may take into consideration mean, median, standard deviation, proportions etc, depending on the nature of our research problem. Most of the educational researches intend to compare the means and hence we limit our discussion to significance of difference of means between two independent samples.

If we want to determine how large the difference that could be considered as a real difference, magnitude of difference of means between the independent samples alone may not help us but the standard error of means also to be taken into consideration. This means that to know how reasonable the difference between two means is large enough to be taken up as real and dependable standard errors of the two means need to be compared instead of their means alone. It is because of the reason that the obtained means are subjected to sampling fluctuations or sampling errors and hence the differences between two means may also due to sampling errors. So it is necessary to compute the standard error of

difference of means (σ_D). From the difference between the sample means and the σ_D, we can determine whether a difference probably exists between the population means. This would help us in verifying the null hypothesis (H_0) stating that [J1-C2 = μ_1-μ_2 where μ_1 & μ_2 are means of two independent samples and μ_1 & μ_2 are their corresponding populations means. A difference is called significant when the probability is high that it cannot be attributed to chance and hence represents a true difference between population means. Standard error of the difference between means (σ_D) can be obtained separately for correlated and uncorrelated means.

Standard error between two uncorrelated means (σ_D) = $\sigma_{(1-2)} = \sqrt{\sigma_1^2 + \sigma_2^2}$;

Where $\sigma_1^2 = \sigma_1^2/N_1$ and $\sigma_2^2 = \sigma_2^2/N_2$

Standard error between two correlated means (σ_D) = $\sqrt{(\sigma_1^2 + \sigma_2^2 - 2r_{12}\,\sigma_1 + \sigma_2)}$

In order to know whether the differences between means are significant or not, we have to compute critical ratio, which is a ratio between the difference of difference between sample and population means and standard error of difference of means.

CR = (1 - 2) - $0/\sigma_D$ (in CR the difference between the two sample means is taken for 0.00 in terms of σ_D).

Levels of significance

One of the important decisions that an educational researcher should take in determining the magnitude of difference that could actually accounts for true difference. How to decide a difference between means as significant statistically? Statistical significance of difference depends on its probability of arising 'by chance'. A difference is considered as 'significant' when it tends to a real difference between population means. In order to decide whether sample difference is compatible to population mean differences, it is necessary to take some critical point or points along the probability scale which will serve as a criteria to decide whether a difference is significant or not. Any of our judgment concerning differences is never absolute, but it spreads over a scale of probability. Our confidence increases as the chances of a wrong judgment decrease. Normally, educational researchers chose certain standards arbitrarily and these are called as levels of significance. Most often in educational research educational researchers fix these standards at 0.05 or 0.01 levels of significance. The confidence with which a null hypothesis is rejected of not rejected depends on the level of significance that a researcher takes into consideration.

Chapter - 12
Qualitative Data

The academic exercises/researches that use qualitative data are considered as qualitative researches. This involves an in-depth understanding of phenomena under consideration. Unlike quantitative research, this relies on reasons behind various occurrences of a phenomenon. Qualitative data is very wide and voluminous. It is difficult to treat such data fully and hence certain data might be skipped without losing the holistic perspective of the problem under investigation. The first task in dealing with the qualitative data is the process where by some data is selected to be included in the report, and other data is omitted. It is clearly important to have precise methodological criteria for selecting some data and rejecting others, but in the context of reporting, it is also important to have a policy on the inclusion of extracts from the data. The usual strategy that you can adopt in dealing with for example interview data is to include verbatim extracts from the interviews in the text of the report. These extracts are employed as the evidential basis of the arguments developed in the report. However, because there is usually a great deal of data available, there is often a natural tendency to include rather too much data. It is necessary to bring a reasonable balance between the number of extracts from the data and the amount of discussion. At one extreme, if there are too many extracts then the data assumes a disproportionate importance in the report and there is insufficient room for analysis. On the other hand, if you provide insufficient quotations, then the arguments in the analysis will not be adequately supported. As with many issues, it is really a question of finding a suitable compromise. An approximate guide might be that the total number of words of analysis should be double the total number of words of quotations. There is difference of opinions in using this strategy but till it is one way of filtering the huge data obtained from interview extracts, What is essential is that the quotations and the analysis are combined into an integrated whole. It is here that the style of writing matters a great deal. It is very easy to a d extracts from interview data, in such a way that they appear as isolated sections of text disembodied from the main writing. Sentences can be added in such a way that they link the analysis and eth extracts. For example, just before an extract from the data, you could write. In the following extract from the interview with the chemistry teacher, she/he highlights the problem of technician resources in the laboratory. This kind of linking sentence provides the reader with an idea of what is to come, and enables the reader to adjust to thinking the content of the abstract. It is relatively straightforward with extracts from interview data, to ensure that the reader is clear that these are quotations. The usual convention is to indent the quotation, and use smaller font, italics, closer line spacing or a combination of these. The quotations are them clearly separated from the main text. Some kinds of data, such as observational data, field notes, and ethnographic data, may be relatively similar to the main text. This may be because they have been written by you only and contain some preliminary analysis. It is important to make sure, when extracts from field notes are used specifically as data that this is made clear by the manner in which the data is inserted in the main text. Interview extracts, reflexive accounts and narratives can be used as evidences for a claim. These evidences are to be rationally put into the argumentation form generating new insights and thoughts about the phenomena user study.

Reflexive Accounts: An interesting addition to the process of analyzing qualitative data is to include in the report a reflexive account. This is essentially an attempt by the researchers to reflect upon their own intellectual background and perspective which have

provided the context for their analysis of the data. The reflexive or reflective account to some extent, serves the purpose of making the readers to attribute more weight to some arguments than to others, depending upon their understanding of the argument within the stated perspective. I acknowledge that though we try to report in an unbiased and balanced manner, it is not easy to achieve this. In the reflexive account you may try to discuss in as open a manner as possible, the various influences which have formed your particular perspective. The assumption then is that the reader will be able to take this into account, in reading and evaluating the analysis of your report. The reflexive account is often placed at the end of the report, although it could be positioned wherever it would be of most use to the reader. A reflexive account can contain a variety of material, depending upon the significance attached by the researcher to the various intellectual influences in his or her life. There may be an account of the courses of study they have undertaken and mention of the institutions where they have been students. Books which the researcher has found particularly helpful or informative may be mentioned, along with conferences attended or countries visited. If relevant, the researcher may also choose to include mention of such issues as the influence of family or friends, various aspects of employment or the influence of spare-time activities. In short, the reflexive account is an opportunity to outline the personal and subjective perspectives which the researcher brings to the data collectiol1aod analysis process.

Conceptual Analysis: some data in the report may derive from the analysis of the concepts used in the research, and may be described as analytic data. In the early stages of a report, for example, it is often necessary to try to define the key concepts which are at the heart of the report. Such definitions will rarely be complete and final, but will at least map out something of the parameters of the terms. For instance, in a report devoted to the theme of 'teacher autonomy' in terms of determining the curriculum, it would probably be very desirable to establish something of a working definition of autonomy, in order to illuminate the later discussions. The problem with a concept such as autonomy is that one person may feel that they have more or less complete freedom of action, whereas another person may feel constrained and restricted, under exactly the same citelrn1stances. One way of proceeding in a case such as this is to identity a number of different situations in which the word autonomy is used in education, and then to explore the characteristics of the use of the word in the different contexts. However, following such analysis, it is unlikely that there will be any truly empirical means by which it can be argued that one 'definition' of autonomy is superior to another definition. One might point to the apparently logical consistencies or inconsistencies of the use of the concept in different situations, but it is unlikely that one could reasonably assert a final definition of autonomy. One would be left with a range of situations within which the term appears to have significant inter-subjective meanings for human beings, and some idea of the logical foundations of those meanings. It is therefore important in a report to be able to recognize those issues which are susceptible to empirical verification and those which require an analysis of concepts.

Chapter - 13
Data Entry

As most of the researchers have access to MS office and it is easily available, data can be entered in MS Excel. This software is user friendly and it is easy to enter data. Hence, the details of using MS Excel are provided.

What is Excel?

An electronic version of a paper ledger is known as a 'spread sheet'. Excel is a spreadsheet program. Microsoft Excel (or MS Excel) is one of the versions of Excel program.

System Requirement for Microsoft Excel for Windows:

- Any IBM compatible machine with an 80286 processor or higher
- A 3.5 inch floppy disk drive
- A hard disk
- A graphic display compatible with Microsoft Windows version 3.1 or later, such as EGA or VGA
- At least 4 megabytes of memory
- Microsoft Windows version 3.1 or later in standard or enhanced mode
- A printer is optional

Starting Microsoft Excel:

- Assume the Microsoft Excel is installed in your computer in Windows 97 environment.
- Turn on your computer and monitor and wait until the Windows 97 desktop appears.
- Windows dialogue box may appear, showing a useful tip or shortcut. Read the tip and then click (using mouse) on close to clear it from screen.
- Now click on the start button at the lower - left corner of the task bar to see a menu of options.
- Move in the menu point to the programs option at the top of the list (you need not click here).
- A sub - menu will appear listing programs, groups of programs, and some Windows 97 functions. There should be a program Microsoft Excel or MS Excel. Click on Microsoft Excel to start the program.
- You should now be looking for Windows screen as shown below.

Excel Screen: The excel screen displays several items to help you perform tasks efficiently. Below are the important displays of Excel Screen.

- At the very top of the screen is the Main Title Bar.
- On the left side of the title bar is the program control menu icon. The letter indicates that this menu controls the entire Excel program.
- Next to control menu icon is the name of the program, followed by the name of the document.

- On the right side of the title bar are three buttons with icons from left to right, they are the Minimize button (reduce Excel to an icon on the Task Bar), the Restore button (changes Excel into a Window) and the Close button (closes Excel)
- *Below the title bar is the Menu bar.*
- On the left-side of the Menu bar is a Worksheet Control icon.
- Next to worksheet control menu icon you find File, Edit, View, Insert, Format, Tools, Data, Window and Help buttons to perform most frequently used operations;
- Below the Menu Bar you find tool bars - Standard, Formatting and Formula. Each button on standard and formatting tool bars offers a shortcut method of performing commonly used file and workbook operations. The formula bar is used to enter and edit cell values.
- Below the tool bars you find the worksheet, a large planning form made up of columns and rows. The Workbook is the normal document or file type in Excel. A workbook is the electronic equivalent of a notebook which is made up of several worksheets. Most of the work you do in Excel will be on a worksheet. A worksheet is a grid of row; and columns, Each cell is the intersection of a row and a column' arid' 'a unique address or reference, Notice that the rows are numbered from top to bottom along the left edge of the worksheet the first row is numbered I, the second 2, and so on. There are 65536 rows. The columns are labeled from left to right with letters. The first column is A, the second is B and so until on IV. There are 256 columns. Each cell is identified by the corresponding column and row number. For example the first cell is identified by A_1
- At the bottom of the worksheet you find sheet Tabs, Status Bar.
- Using scroll bar you can bring worksheet into view that does not fit on the Window.
- The first cell of the worksheet will be highlighted. This is the indication of the cell where your entry goes in. Generally, you first select the cell or cells you want to work with and then you enter data of choose a command. Selected cell appear highlighted on your screen. The active cell is the cell in which data is entered when you start typing. Only one cell is active at a time. The active cell is shown by a heavy border. To change the active cell, move the mouse pointer to the new cell and click. You can also change the active cell with the help of arrow buttons on your keyboard.

Creating a New Workbook:

- When you start Excel, a new workbook opens. To begin working, just start typing. If you want to create a new workbook at any time, click the New Worksheet button. You can also choose the new command from the File menu.

Entering Data into a Cell:

- Open the worksheet.
- Select cell where you want to enter the data by using mouse/arrow buttons.
- Type the data and press ENTER.
- The selection moves down. You can press arrow buttons on the keyboard instead of ENTER button.

Cancelling an Entry:

- To cancel an entry before you have pressed ENTER, press the ESC key.
- If you have already pressed ENTER, choose the Undo Entry command on the Edit menu.

Types of Data that can be entered in Excel Worksheet:

- You can enter two types of data - a constant value and a formula.
- A constant value can be numeric value, a date, time, currency, percentage, fraction or scientific notation or any text.
- A formula is a sequence of values, cells references, names, functions, or operators that produces a new value from existing values. Formulas always begin with an equal sign (=). A value that is produced as the result of a formula will change when other values in the worksheet change.

Formatting Numbers:

- When you create a new worksheet, all cells are formatted with general number format - using integer format, decimal fraction format, or if the number is longer than the width of the cell, scientific notation.
- You can change this number format.
- Click in a cell that contains a number or enter a number in a cell. Click Format and select Cells to display the Format Cells dialog box. Click on the number tab to present the display options.
- Select the option and click OK button.

Filling Adjacent Cells and Creating Series:

- You can type any number or numerical series directly into any Excel cell.
- Click in the first cell you want to use.
- Enter number you want to repeat.
- Select the range of cells you want to fill, including the, number you just entered.
- Click Edit and select Fill option.
- From the dialog box choose the desired direction up, down, left or right and click OK.
- Excel copies the number you entered into the first cell into all the selected cells.
- Enter the first number of the series. Notice that there is a slight protrusion in the lower right - hand corner of the cell.
- Move the mouse pointer over this 'handle' until the pointer changes to a crosshair.
- Press the left mouse button and drag the highlight across the cells you want to fill.
- Excel copies the original value into the selected range.

To create a Numbered List:

Click in the first cell, the one that will be the number 1.

- Type 1 and press ENTER.
- Type 2 and press ENTER.

- Select the cells you want to contain the series, including the cells you have just numbered.
- Click Edit and choose Fill Series option to display the Series dialog box.
- Select Column in the Series in group.
- Select Linear in the Type group.
- Type in the Step value field.
- Type the last number in the series in the Stop value field, or leave it blank.
- Click OK to number the cells.
  You could fill a series of cells with the days of the week, the months of the year or even an irregular series.

Editing Text in a Cell:

- Select the cell that contains the information you want to change.
- Press F2 or double click the cell you want to edit.
- You can use Backspace key or Delete key or Insert key to modify the contents of the cell.

Moving Data from one location to another location of Excel:

- Select the cell that contains the data you want to move.
- Grab any border of the cell and drag it to the new location. If you try to drop the moved text onto a cell that is occupied, Excel warns (you can choose the option).
- Select the cell that contains the data you want to move.
- Click Edit and Cut.
- Move the mouse cursor to the cell where you want to place.
- Click Edit and Paste.

Finding Numbers and Text:

- Click Edit and Find
- Type the text or value you want to locate in the Find What field.
- Select whether you want Excel to search by row or column.
- Pull down the list in the Look in Field and specify where you want Excel to look for the requested data.
- Click OK to begin the Search.
- Press Esc to close the Find dialog box.

Find and Replace Data:

- Click Edit and Replace to display Replace dialog box.
- Type the value you want to replace in the Find What field.
- Type the value you want to place over the old value in the Replace with field. Click Find Next to jump to the first occurrence of the Find What data.
- Click Replace to have Excel substitute the new text for the original.

What is Formula?

- A formula is an algebraic expression. You can use literals (actual numbers entered as part of the formula), variables (letters or names that represent numbers), and cell references as part of formulas. Formula should be entered in a cell after typing equal sign (=).

Sorting the data in a Column:

- Select the column.
- Click Data and Sort options. Sort dialog box appears.
- Choose the options and click OK.

What is a Function?

- A function is like a formula, but it is accessed through a built - in command that you enter in a spreadsheet cell. For example, if you want to add up the contents of a range of cells you could use the add operator (the plus sign) and the individual cell designators to produce the results or you could use the sum. Function (SUM A3:A20).

To find the sum of the Values in a Column/Row:

- Highlight the cells whose sum is required.
- Highlight a cell to provide space for the sum.
- Click Σ button on the standard tool bar.

Calculation using Basic Functions:

- Excel contains many useful functions. You can type a function, or a formula that contains a function directly into any Excel also contains a Junction bar to help automate the task.
- Click in the cell you want to hold the function.
- Click on the equal sign next to the Formula bar. Excel copies the equal sign into the formula bar and the current cell and also displays the Function bar.
- Type any characters that are part of the formula outside of the function you want to use.
- Click on the down arrow next to the sum function on the Function bar to display a list of common functions.
- Choose a function from the list by clicking on it. Excel displays a range selection dialog box.
- Enter a new range. The results of your formula or function appear at the, bottom of this dialog box.
- Click on OK to close the dialog box and enter the function with its arguments in the current cell.

Formatting the Worksheet:

- Enter the values you want to use in the Excel sheet.
- Click File and Save As to store the spreadsheet
- Click Format and Auto format to display the dialog box.
- Use the vertical scroll bar to step through the available Auto format designs. A preview of each design is displayed if you click on the design name.
- Click on the Auto format design you want to use and click on OK to close the Auto format dialog box and format the sheet or selected sheet area.

Hiding Columns/Rows:

- When large sized data consisting of several rows and columns are to be entered, it is difficult to keep the title of the data and data being entered in the same screen. In such Gases, the data in between along with its row/column can be hidden.
- To hide a set of rows/columns, first select the area to be hidden.
- Click Format and Row/Column.
- Click on Hide.
- To unhide the hidden rows/columns, follow the same steps and click on Unhide.

Formatting Gridlines:

- Excel places a grid line around every cell, but you can control which cells or groups of cells have a border to provide emphasis or focus for portions of a sheet.
- To enable or disable gridlines or change grid line colors, do the following.
- Open the sheet you want to format.
- Use Tools and Options to display the. Options dialog box.
- Click on the View tab to get the display box.
- Uncheck the Gridlines box at the lower left of the Windows options group to turn off Gridlines display. (Click OK here if you do not want any other effects).
- To change the gridline color, pull down the list of colors attached to the color field of the dialog box. Click on a color form the pop up display to select it. Click on OK to make the changes effective and close the dialog box.

Creating Borders:

- Highlight the cells for which you want to add a border.
- Click on the down arrow beside the Borders icon on the Excel Format toolbar to display the border choices.
- Click on the border type you want to enable. Excel updates the selected sheet area and closes the border selection dialog box.

Page Setup for Printing:

- Click File and Page Setup to display the dialog box.
- The first one is the Page Tab. Here you specify the page orientation, scaling, print quality and paper size.

- Use the Margins tab to specify how much space you want to allow around the outside of the paper when you print.
- Use Header/Footer tab to print Header and Footer.
- Excel automatically creates a header and footer for printed sheets as default Excel offers several choices for header and footer, which you can select from the pull down list beneath the header or footer field.
- The Sheet tab of the Page Setup dialog box offers still more options for formatting your sheet print out. The first option on this tab lets you specify a print area. By default, Excel automatically chooses an area of your sheet to print, based on which cells contain data. You can use the first field on this tab to print a subset of the sheet. Click on the sheet icon to the right of this field, and Excel removes the entire dialog box except the Print Area field. Now you can use your mouse to select the portion of the total sheet you want to print. Excel fills in cell references. Click again on the sheet icon on the right of this field to restore the sheet tab display. You can also select the Print area by clicking the File and Print Area.
- You can establish column headings and row lines to be repeated on every page as it prints. This can work like the Print Area facility by clicking on the sheet icon to the right of the Rows to repeat at top and the columns to repeat at left fields.
- If you slick on the Over then Down button, Excel prints the sheet left to right, one page deep, and then it moves the print area down one page and prints left to right again.

Printing :

- Click on File and Preview to view on the screen the sheet as it will be printed.
- Click Close button.
- Click File and print option to display Print dialog box.
- Pull down a list of Printers by clicking on the down arrow to the right of the Printer Field at the top of the dialog box.
- Click on the printer you want and the print out will appear on the screen.
- In addition two groups on this dialog box help you decide what to print, the Print Range and the Print what groups. By default, the Print Range is set for the entire active area of the current sheet you can decide only the first page or any page or range of pages.
- You can also select a portion of the sheet before you display the Print dialog box, and then clickon selection to print only that portion of the sheet.
- Click Properties to display properties dialog box. From this you will have options to set page orientation paper source and other printer features.
- Most of us print Excel sheets directly to a printer most of the time. However, you can choose to print to a file if you wish. For this click on Print to file on the Print dialog box. Excel will ask for the name of the file in which to store the information after you click on OK on this dialog box. Provide a path and file name.
- After specifying all the requirements click OK to start printing.

Excel Charts:

- An Excel chart is simply a picture of your data.
- You can see the basic chart types available in Excel by viewing the first screen of the Chart Wizard dialog box.
- The Chart Wizard helps you create charts by offering suggestions for data input chart type and other chart features.
- Click on the Chart Wizard icon on the tool bar to display the standard chart type list '
- You may select anyone of them by clicking its name.

Excel Chart Components:

- Titles: The chart name or the name of the certain chart components.
- Legends: Labels and colors or patterns that describe the data components of a chart.
- Labels: Text that labels data values or other chart components.
- Data: The values upon which a chart is based.
- Data Table: A sheet like table that displays actual values associated with the current chart.
- Gridlines: Lines across a chart that help you interpret precise data values.
- Trend lines: A data analysis tool that helps predicts trends.

Creating Chart:

- Open Excel and enter the values.
- Use the mouse to select the data in the columns, including the column title.
- Click on the Chart Wizard icon on the toolbar to display the opening Wizard dialog box.
- Select the name of the chart and type of the format.
- Click on Next to display the second wizard screen. This screen shows you how the basic chart will appear, and it shows the cells included in the data area of the chart.
- Click on Next to display the Chart Options dialog box.
- Type the Chart title in the Chart Title field of this dialog box.
- Enter additional titles for the X and Y axes if you wish (whatever necessary).
- Enter additional information regarding the other tabs, if necessary.
- Click Next to move to the final Wizard screen. This dialog box lets you decide whether you want to insert the chart into the current sheet or as separate object in a sheet of its own inside the current workbook.
- You may put the chart into the current sheet and click Finish to accept the default and create the chart.
- Grab the finished chart and drag it to a vacant portion of the current sheet so that you can still work with the original data.
- You can create any chart in the same way.

Chapter - 14
Writing Research Report

Epistemic purposes of academic writing: Academic activities and projects cannot happen in vacuum. They are deliberate attempts to attain specified goals. Writing about these activities involves development of truth claims through objective or subjective evidences/experiences. Validation of the truth claims is a latent purpose of any academic writing. Development of substantial justification to the claims by linking the ideas of earlier thinkers and providing opportunities to generate innovative ideas to initiate some more academic activities/projects are the two major essential components of any academic exercise. One of the important steps in these endeavors is to examine the existing literature in the field that acts as anchor point to develop an argument. The purpose of academic writing is not to just describing what has been done but to provide new insights and perspectives. The perspectives that are generated should act as a ground of fertility to future academic workers in ventilating their ideas by corroborating, the present claim or generating new claims. People in academics may vary in their conceptions about particular phenomena with a variation in perspectives. Such varied perspectives generate wide range of nomenclature in the academic field. It is thus essential to provide our perspective by providing specific workable meaning to the terms that have use in our academic activities. Further arguments would be within this frame of
Reference. Reality and truth are the two basic foundation stones on which the entire edifice of academic work and writing is built. Hence it is essential to incorporate both reality and truth perspectives in any academic writing. As a matter of fact they should be kept in mind while planning the activity itself. These ontological and epistemological issues would ultimately provide direction to conduct an academic activity i.e. the methodology.

Characteristics of good academic writing: A clear title and abstract which accurately reflect the nature of the academic activity or the project.

- A structure and format which help the reader to absorb the subject matter.
- An intellectual coherence which starts with precise aims, from which follow the design and a clear conclusion.
- Accuracy in grammar and punctuation.
- Consistency in referring, presentation and the use of terms,
- Should be free from bias - personal feeling and attitudes of the writer or the researcher.
- Justification of arguments should be based on sound logic and evidence Judicious use of technical vocabulary and terms

Variations in data and attributing meaning: The basis for any academic writing is available data. There are many forms of data. Each form of data requires different treatment while attempting to attribute meaning. Data may be in qualitative or quantitative form. Quantitative data constitute information collected through questionnaires and other scales in a survey. Such data may be called as survey data. Qualitative data constitute information obtained through interview or by using some ethno-methodological techniques. As such data do not carry any meaning. But through analysis meaning can be attributed to data with the help of a clear theoretical perspective. Efficacy of academic writing depends on the sound theoretical frame. This theoretical

frame of reference determine how data be treated to attribute meaning. Quantitative data treatment is mostly carried out with the help of appropriate statistical techniques. Choice of statistics again depends on nature of data available and the objectives of academic endeavor. The data may be obtained from a probability or non-probability sample. Statistical choice is made on the basis of source and nature of data coupled with the research problem under investigation. Nature of data and the problem helps in deciding whether to rely on descriptive or inferential statistics. Inferential statistics are basically used in case of probability samples. These statistics actually do not indicate whether claims are true or not, but provide evidence for likelihood of something being true. Unlike quantitative data, qualitative data can not be put into a form of numerical expression. Qualitative data is extensive and hence condensation of such data requires judicious judgment in order to make it manageable to use it as evidence for an assumption or claim.

Qualitative data: The academic exercises/researches that use qualitative data are considered as qualitative researches. This involves an in-depth understanding of phenomena under consideration. Unlike quantitative research, this relies on reasons behind various occurrences of a phenomenon. Qualitative data is very wide and voluminous. It is difficult to treat such data fully and hence certain data might be skipped without loosing the holistic perspective of the problem under investigation. Interview extracts, reflexive accounts and narratives can be used as evidences for a claim. These evidences are to be rationally put into the argumentation for generating new insights and thoughts about the phenomena under study.

Case studies: The case study is one of several ways of doing educational research. Rather than using large samples and following a rigid protocol to examine a limited number of variables, case study methods involve an in depth, longitudinal examination of a single instance or event: a case. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As a result the researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. Case study research means single and multiple case studies can include quantitative evidence, relies on multiple sources of evidence. Case studies should not be confused with qualitative research and they can be based on any mix of quantitative and qualitative evidence.

Ideation of data: Criteria for selection of data: There are a variety of possible ways to select some data for analysis and to discard other data. Each of these ways may be more relevant in some contexts than other. Formalities of presentation are less precisely - defined in presenting qualitative data than in presenting quantitative data. Analysis of quantitative data is carried through use of statistical techniques.

Integration of qualitative and quantitative data: Qualitative data helps in investigating 'why' and 'how' of a truth claim, where as quantitative .data helps in establishing 'what', where' and 'when' of a phenomena. Qualitative data obtained from focused samples as against large random samples of quantitative data. Qualitative data need to be categorized into patterns as the primary basis for organization. Quantitative data relies exclusively on analysis of numerical expressions. Qualitative data provides a platform for exploration. For holistic view of the results of an academic endeavor, reports should use both the forms of data for generating viable and potential arguments. Quantitative data analysis needs to

be supplemented with qualitative data that provides clues pertaining to certain measures that are beyond ontological purview.

Planning the report: The Preliminary Outline: This provides purpose and direction of the academic activity to be reported. Before start writing the report, it is necessary to prepare a preliminary outline of the report or at least major issues. Establish content hierarchy in the main body of your text. For this purpose you should be aware of:

- the levels of generality in your material - sometimes called the hierarchy of elements
- the planning skill of outlining the structure of the elements in your text

Inductive and Deductive structure of an Argument: Inductive thinking is working from specific facts or observations to general principles and reaching your conclusions (your position) only after you have examined the evidence, Deductive thinking is working from principle or central position on an issue, supporting that position with a logical argument. Complete with examples and citations of other authorities and justifying the stand you took at the beginning, inductive arguments emphasize exploration and observation, draw inferences from empirical data, leads toward a claim for validity of those inferences and correspond to the empirical research report type of text. Deductive arguments are more certain-they are either valid or invalid and correspond closely to the essay style of writing. Balancing inductive and deductive approaches: Academic essays and research reports are not necessarily exclusively inductive or deductive. Taking a process approach to either the essay or the investigative project will show that each features both approaches. Most extended texts inevitably follow a general --> specific -> general structure, as they draw the reader in with some general background and context, and then close by making some summary points or drawing some conclusions.

The IMRAD structure provides the best framework for reporting:
- Introduction: What you plan to do
- Methodology: What you did
- Results: What you found and
- Discussion: What it all means

The IMRAD structure accommodates further sub-division along both functional and topical lines. Function based sub-divisions may be on subjects (sample), tools and procedure. Examples of topic-based sub-headings are language attitudes, language teaching approaches, language performance and so on.

Language aptness: While reporting better frame sentences short and simple. This will be safe to avoid errors in language. Simplicity and brevity are certainly virtues in writing; bur should not be pursued at the expense of reason or complexity in your assertions. There is a correlation between length and richness of expression. Assertions in academic communication generally need to be longer than in everyday communication because the standards we set for accuracy and reasonableness are much higher. There are eight of dimensions of 'fine tuning' of expression and meaning. What do you find problematic about this statement? '*Students will go on strike because they think that instructional procedures are too poor*'. Let us see how the above statement can be made more "delicate" - and at the same time more "powerful". Through attention to the following qualities or

dimensions, let us explore these one by one, in sequence, building on the above "problem" statement. You're advised to work through these in the sequence developed below, as the above example is expanded cumulatively.

1. Probability/certainty: You often express your views in an over-certain manner, and are particularly fond *of* the "will" form, for example in the statement students will go on strike, there is element of certainty. But we are not sure whether workers go on strike or not. Instead It is better to use statement like - students may/might *go* on strike

2. *Generality/Scope:* You also tend not to define your referents or population sufficiently narrowly or accurately, in relation to the claim you are making, e.g. 'students', you are not about which students - students in Bhopal or Raipur or elsewhere: in secondary school or in a higher education institution; all students in Bhopal/Raipur or many students in Bhopal, Raipur or some students in Bhopal/Raipur. You may also face problems of 'reference' involving misuse of the 'article', both definite ("the"), indefinite ("a") and zero article, ("some")

3. Tentativeness/Fact/Belief Status: This is a common problem, firstly stating a future action as a definite fact (students will...). And using the simple present to imply certainty about a belief or attitude (they think...). How do you know what they will do or what they think? Instead of this, the statement should he like this 'Students may go on strike because they are complaining that ...'

4. Contingency/Circumstance: It is suggested that there should be some condition or circumstance for the idea or proposition which can be included in the same sentence, e.g. Students in Raipur may go on strike over poor instructional procedures (Regardless ?!), unless the administration promises to review their case. Notice how this has resulted in a more economic form of expression.

5. *Relativity:* Often an absolute measure needs replacing by a relative comment, making comparisons with another, time, place or set of circumstances e.g., "Higher class students are more (or increasingly) likely to strike than the lower class students, as they have more to loss"

6. *Attribution:* In academic communication, assertions that are not our own speculation usually need attributing to their original source i.e. who says so?! E.g. "**Students in Bhopal may go on strike over poor instruction unless the college authorities assure to take steps to improve instructional efficacy**" e.g. Sources in the student's council report that ...or Prof. Xyz, Principal of the college stated that... Note the difference in tone and function once source is named. But no change is required if you use the neutral option: "According to Prof. Xyz, Principal of..., the students may go on strike if...".

7. *Concession:* It might be that the college authorities had already promised to rectify instruction, and that they had decided to threaten to strike despite that promise, i.e., we now brings in the 'circumstances' in which this assertion is valid. We call clauses beginning with despite, although and while "concessive" clauses. E.g. Sources in the *College Authority* report that students may go on strike over poor instruction unless the college administration promises to improve instructional quality,

8 *Presupposition:* This relates to the *assumptions* you often make about the things you are writing about, what you are referring to. You need to ask yourself if your reader is liable to understand concepts or organizations you refer to which have not previously (or subsequently) introduced in the text. This is called as "presupposition", or making assumptions about "given" information. E.g. If you feel that the reader may be unsure of what the *College Authority* is, you might need to add "Sources in the College Authority, the department of college dealing with students' service, report that...

Writing different aspects of a study in research report:

Abstract: This is the summary of the academic writing. Entire academic report is written in precise highlighting the main features of the academic work/project. Abstracts (and Summaries) serve to reduce a long text to its essential key points summing up the study. Main aspects to be included in the structure of an abstract are

- Problem issue
- Methods
- Findings and Interpretation
- Conclusions
- Implications and recommendations for future research

Introduction: The introduction to the research or investigative report provides the reader with important information for navigating the rest of the text. Hence, you should keep in mind following aspects while writing introduction.

- Establish the field
- Summarize previous research
- Create a research space
- Introduce research project
- Further following points also to be kept in mind while making initial statements Or truth claims
- Why is this activity being conducted?
- What is the significance of this activity?
- Explaining the context of the activity Aims of the activity

Methodology: The ground realities (ontological issues) that you have enumerated/identified would decide the methodology of your project/research work. Besides, your methodology should be compatible to aims of project/research activity. Following are the pertinent aspects that should be spelled out in methodology.

- Overall design
- Selection of the sample
- The process by which data is collected
- Data analysis
    - Statistical analysis
    - Comparing quantitative and qualitative analysis
- Strengths and limitations of methodology

Results: Report findings objectively, without making any kind of interpretation of those findings. The results section provides an account of what is found. Balancing the objectivity of results with interpretation is essential to link the evidences and the claim.

Discussion: This generally follows findings and interpretation (or findings and then discussion). It should match the introduction in the way it moves - from a close focus on study and to relating that study more broadly, to other work in the field. The argument allows to step back to a more general level of discussion, and to relate findings to those of other researchers - particularly to the literature reviewed in the introduction. It is important to be able to control the strength of the claims. Many writers make claims for which they have insufficient evidence. Establishing a fine sense of the relationship between the strength of a claim (a position or assertion) and the strength of the evidence for that claim is essential while interpreting the results. A Recommendation is generally included at the end of a general discussion. It may propose an action or further research.

Conclusions: Conclusions are the exact contribution to the field. Conclusion should be neither summary nor restatement. Instead, it must go beyond the study to reach a judgl11ent, to endorse one side of an issue, to discuss findings, or to offer directives. To put it succinctly, it should say something worthwhile. The important thing to remember about the conclusion is that the reader expects to be able to leave your text with your main message - or at least an idea of what you have achieved. In addition to the content of a conclusion - what should be included and excluded - it is worth considering the perspective taken at this concluding point in communicating with the reader. A conclusion can be seen as being both backward-looking & forward-looking.

Bibliography: A bibliography is a list of magazines, books and newspapers that have been consulted in a research/academic work. There are many different ways to write a bibliography. The bibliography format used here is based on MLA style. Some of the important tips in writing bibliography are:

- The book or magazine title is always underlined in a bibliography
- If a citation is more than one line long, indent the second line five spaces
- Put the bibliography in alphabetical order, by the author's last name. If there is no author listed, use the first word of the title (not 'a', 'an', or 'the')
- When there is more than one author, list the authors in the order they are listed on the title page
- If you use information form an article in a book or magazine, the article is listed before the title

Activities for Conducting Research
Selection of Research Area
Activity Sheet - 1

In order to select your research problem, you are required to choose the area in which you wish to undertake the research. Select any one area and mention the general issue/problem you wish to investigate along with its significance and justification.

List some of educational issues/practices that are bothering you	
Areas	Educational Issues/Problem : Its Significance and justification
Evaluation Distance Education Learning Teaching/Instruction Elementary Education Teacher Education Special Education Guidance & Counseling Science Education Mathematics Education Language Education Teacher Attributes Student Attributes Instructional Technology Curriculum Design Textbooks Vocational Education Social and Group Dynamics Educational Programs School Management Economics of Education Non Formal Education Health Education Physical Education Organizational Climate Aesthetic Education Pedagogical Issues Innovative Practices Any other (specify)	

Sources of Research Problem
Activity Sheet - 2

This is the first step that helps you to initiate educational research. During critical observation you may notice many things that pertain to teacher behavior, teaching, student behavior, learning, community/social context and content/curriculum. Some aspects may bother your mind and some may not. The aspects that bother you are the contexts to undertake educational research.

List some of educational issues/practices that are bothering you	
Source	Educational Issues/Practices
Teacher Behavior	
Teaching/Instruction	
Student Behavior	
Learning	
Social Context	
Content/Curriculum	
Any Other (Specify)	

Components of Research Problem
Activity Sheet - 3

Research problem can be attributed to an individual or group or organization. It occupies an environment and contains some possible outcomes. Before arriving at a research problem it is necessary to spell out such components.

Target Group/Institutions : What is to be explored/studied? Courses of action, if any : Environment : Expected outcomes :

Defining the Research Problem
Activity Sheet - 4

You have already identified the topic. Elaborate it in order to define the problem in clear terms.

State the problem in general terms (elaborate your topic):

Research Gaps/theoretical background (if any):

Changes, if any, in problem with reasons (after discussion):

Define the Problem:

List out the Variables:

Define technical terms/variables:

State basic assumptions :

Provide criteria for selection of problem:

Time and source of data:

Scope of the problem:

Evaluation of Research Problem
Activity Sheet - 5

After selection of research problem and its description, it is necessary to evaluate the problem in terms of your competencies, time and other factors. Evaluate your research problem by answering the questions.

Questions pertaining to nature and significance of the problem			
S.No.	Question	Yes	No
1	Is this type of problem effectively solved through research?		
2	Can relevant data be gathered to test the theory or answer the question under consideration?		
3	Is it significant?		
4	Is an important principle/issue involved?		
5	Would the solution make any difference as far as educational theory or practice is concerned?		
6	Is it new one?		
7	If it is a replicable, is it worth to verify it to different populations or situations?		
8	Is research on this problem feasible?		
Questions pertaining to researcher's capability and other related matters			
S.No.	Question	Yes	No
1	Am I competent to plan and carry out a study of this type?		
2	Do I know enough about this field/area to understand its significant aspects and interpret my findings?		
3	Am I skillful enough to prepare tools required for data collection?		
4	Are pertinent data accessible?		
5	Will I have necessary financial resources?		
6	Will I have enough time to complete this project?		
7	Will I have the determination to pursue the study despite the difficulties?		
8	Will I be able to succeed when data are difficult to gather?		
Remarks :			

Theoretical Framework and Formulation of Objectives
Activity - 6

While planning your research, you should have clear perspective about its purpose. Please do this activity. This would equip you with the skill of comprehending your research problem in holistic perspective and formulate objectives.

Define the goals of your research activity :

Describe the contours :

What are the ground realities?

What are your truth claims?

Evidences/Experiences for truth claims : (if possible subjective and objective separately)

Validation of truth claims :

S.No.	Truth Claim	Link to literature/researches	Scope for further innovation

Working definitions of terms :

1.

2.

3.

Objectives:

1.

2.

3.

Selection of Sample
Activity Sheet - 7

Depending on the nature of your research problem, you will be arriving at different sources of data required. Basing on the sources of data, you will have to decide the sample. This activity will help you in selection of sample.

List out the variables in your study :

Types of Data required (Qualitative/Quantitative) :

Sources of Data :

Population (Describe the populations basing on the sources of data) :

Samples (samples drawn from different populations) :

Type of samples: Probability or Non-probability

Procedures of selecting samples :

Identification of Tools to collect Data
Activity Sheet - 8

You have already identified your problem and the data required for carrying your research. Decide the tools for collecting the required data.

What are the variables you intend to measure?
1.

2.

3.

Mention the techniques to collect data :
1. Observation : Check List, Schedule, rating scale

2. Interview : Structured, Unstructured

3. Survey : Questionnaire, Rating Scale, Test

What are the tools required to collect data?

S.No.	Tool	Available/Not available
1		
2		
3		
4		
5		

Preparation of Tools
Activity Sheet - 9

While doing activity on identification of tools to collect data, you have identified tools that are available and not available. If a tool is available, you can use it for your study depending on its suitability and appropriateness to your study. If the tool is not available, you have to prepare it on the basis of certain criteria of variables. This activity would help you in preparing tools.

Operationally define your variables :

List out various components behavioral indicators to measure the variables:

Decide the nature of items to be prepared

1. Open Ended 2. Objective (one and only one answer) 3. Scale

Decide how you want the target group to respond (Response Pattern)

1. Two Point (yes/no or right/wrong) 2. Three Point

Prepare the draft items basing on the behavioral indicators already mentioned

Scrutinize the items with collaborators/colleagues

Finalize the items

Recording the Data
Activity Sheet - 10

Recording the evidences is a most essential competency required to a researcher. Most of the researches fail because of failure in recording the evidences. You may collect the evidences through testing or non-testing procedures. If your evidences are collected through testing procedures these test scores are recorded. If the evidences are collected through non-testing procedures, it is required to prepare a structure. This activity would help you in developing the competency of recording the evidences.

Recording the evidences collected through testing procedures :

Most of the evidences you get from questionnaires, rating scales and tests. All of this can be quantified specifically on the basis of assigning different numbers to different response categories (Scoring). Record these scores in following table.

S.No.	Name of the respondent	T1	T2	T3	T4	T5
1						
2						
3						

Recording the evidences collected through non-testing procedures :

Mention the aspects that you wish to observe :

Prepare a checklist, schedule or rating scale :

Designing the Experiment
Activity Sheet - 11

In order to verify your hypotheses, you need to carry out a research study or an experiment. There are many designs of experimentation. Your experiment depends on how you treat your variables to establish evidences to prove or disprove your hypotheses.

Your sample :

Variables :

Whether intend to observe the change or to observe the status/measures :

If you want to observe the change, tick how you want to observe the change :

1. Entry behavior and Exit behavior
2. Exit behavior only
3. Specific behavioral changes during experimentation
4. Exit behavior only with a control group

If you want to observe the status/measure, mention the measures/variables and their treatment :

Accordingly write your experimental design/research design :

Experimental Control, if any :