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CHAPTER-1

RESEARCH APTITUDE

PADHO TO AISE

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7. RESEARCH

MEANING OF RESEARCH

Research is the careful, detailed and systematic process of studying materials and sources by means of an organised investigation, experimenting and fact finding with the aim of solving problems, establishing facts and reaching new conclusions. It is a study into a specific problem, concern, or issue using the scientific method.

PURPOSE OF RESEARCH

A research is undertaken for any of the following purposes:

1. To gain new insight into a phenomenon; for which a new research problem or hypothesis is formulated.

2. To investigate the characteristics of an individual or group event/ situation; for which the design is descriptive and an initial hypothesis is optional.

3. To determine the frequency of some occurrence or something associated with an occurrence; for which initial hypothesis is optional.

4. To experimentally and scientifically test the causal relationship between testable variables in a controlled environment.

OBJECTIVES OF RESEARCH

Objectives may be general and/or specific.

The **General Objectives** are the broad goals of any research study, as summarised below:

1. To review an existing body of knowledge/phenomenon

2. To explore and analyse a problem/question/issue/cause

3. To gain new insight into an existing body of knowledge/ phenomenon

4. To investigate and understand a new phenomenon

5. To suggest solution/answer to the research problem/question

6. To produce/construct/generate new knowledge

The S**pecific Objectives** of a particular research study are short term and narrow in focus. They are constructed in accordance with Bloom's Taxonomy of human cognition, using verbs pertaining to the various domains, as suggested below:

Knowledge: identify, record, relate, define, describe, indicate, outline, state

Application: apply, compute, calculate, demonstrate, measure, illustrate, demonstrate, discover, examine, interpolate, classify, solve, divide, modify, manipulate, produce, show, translate, use

Analysis: develop, infer, differentiate, appraise, analyze, identify, deduce, measure, analyze, separate, break down, detect, illustrate, outline, test

Comprehension: extrapolate, assess, generalize, compare, classify, predict, understand, associate, convert, discuss, explain, extend, predict, summarize

Evaluation: determine, measure, project, evaluate, compare, assess, conclude, contrast, criticize, grade, interpret, judge justify, rank, support Synthesis: integrate, compile, construct, reconstruct, create, design, organize, combine, compose, develop, formulate, categorize, devise, generate

ESSENTIAL CHARACTERISTICS OF RESEARCH

A genuine and valued research study invariably has the following essential characteristics:

1. Thoroughly planned in
2. Systematic in approach
3. Collects empirical data in real time from actual observations in natural settings
4. Objective (observation, tests, evaluation are free from researcher's bias)
5. Accurate in procedures, instruments, tests, measurements, etc.
6. In-depth data analysis eliminating errors/anomalies
7. Logical (uses deductive and inductive reasoning)
8. Reliable (is consistent in results)

9. Valid (results truly represent what the research study intended to measure)

i. Face/logical validity—superficial and subjective view of participants about how well tests/tools (questionnaire, interview, etc.) measure what they intend to.

ii. Internal validity— how well pronounced is the causal relationship between the variables, particularly in experimental research.

iii. External validity—extent to which the outcome of a study may apply to other settings.

iv. Content validity— extent to which the tests/ measurements cover all aspects of the construct

v. Construct validity—how well the tests/measurements/ scores actually test the hypothesis or theory they are measuring

Convergent construct validity: constructs which are meant to be related are related. Discriminant construct validity: constructs not expected to be related are unrelated. Good construct validity is ensured by a strong convergent construct validity and no discriminant construct validity.

vi. Criterion/concrete validity—extent to which a measure is related to an outcome.

10. Verifiable/ Justifiable (other researchers may test the validity of the outcome)

11. Controllable (can control and minimize the influence of unrequired factors while testing causality between two variables)

12. Relevant (adds new knowledge or fills gaps in the existing body of knowledge)

13. Generalisable (sample results apply to the entire population from where sample is collected)

14. Ethical (researchers invariably follow moral principles in the process of conducting their research)

15. Cyclic/ (starts with a research question and generates new questions for further research)

TYPES OF RESEARCH PARADIGM

A research paradigm is a specific model of conducting a research that has been validated and practised by researchers for many years. Every research uses one research paradigm to develop the research methodology for a valid and appropriate study.

1. Positivism

According to the positivist paradigm of exploring social reality, true knowledge is based on experience of senses and can be obtained by observation and experiment. It emphasizes quantitative analysis over qualitative analysis. Determinism, empiricism, parsimony and generality are the defining characteristics of Positivistic research.

2. Constructivism/Interpretivism

It developed as a critique of positivism in social sciences. It opposes the positivist idea that knowledge can only be generated through a scientific method; and argues that it is rather constructed by the researcher. It holds that knowledge and therefore all meaningful reality as such, is constructed when information comes into contact with existing knowledge based on human experiences. Thus, it emphasizes qualitative analysis over quantitative analysis.

3. Post-Positivism

It is an effective paradigm for social and educational research. It is a balanced combination of positivism and interpretivism approaches and focuses on researching issues in the context of experiences of the majority, declaring the opinion of the majority as their result.

4. Pragmatism

It adopts the modified philosophical assumptions between the two extreme mutually exclusive paradigms of Positivism and Interpretivism. Pragmatists take directed action as the starting point for theory, and understand experience as a transaction between the organism and the environment that constitutes both the subject and the object of knowledge.

5. Transformative Paradigm

Transformative research paradigm focuses on the marginalized communities, analyses the power differentials that have effected the marginalization, and applies the

research findings to actions directed at ending inconsistencies.

6. Critical Theory

It is a school of philosophy which challenges the dominant ways of exploring and explaining organizational phenomenon and offers alternative possibilities that include the marginalised into the mainstream. Its epistemology is dialectical reason. Its ontology includes critiques of the political economy, of domination and exploitation and of ideology. Its praxeology consists of critical ethics, struggles and political practice. It is more or less similar to the transformative paradigm.

Table of Comparison: Research Paradigms

Paradigm	Ontology	Epistemology	Approach & Methodology (or Praxeology)	Axiology
Positivism	The reality is objective and perceived	Acquisition of knowledge is not related to values and moral content	Deductive Approach; Quantitative methods (experiment, quasi-experiment)	Research is value- free; researcher is objective and independent of the data.
Constructivism	Reality is subjective, socially and experimentally relative, and local	The knowledge consists of mental structures that are	Predominantly Qualitative: Case study, interview	Research is value laden; researcher is biased by world views,

	and specific in nature	surrounded by the relative agreements		cultural experiences and upbringings .
Interpretivism	Researcher and reality are inseparable	Knowledge is based on the abstract descriptions of meanings, formed of human experiences	Inductive approach; Predominantly Qualitative methods (Case study, interview, phenomenology, ethnography, ethnomethodology	Research is value bound; researcher is subjective being part of the subject under research
Pragmatism	The reality is ambiguous, but based on the language, history, and culture respect	Knowledge is derived from experience. The researcher restores subjectively assigned and “objective” meaning of	Qualitative and/or Quantitative: Interview, case study, survey, experiment	Values are instrumental in interpreting results; the researcher adopts both objective and subjective points of view—generally

		other actions		tested ethical values being acceptable to all.
Transformative	Multiple realities are shaped by social, political, cultural, economic, ethnic, gender, disability and other values.	Knowledge is contextual to social and historical situation and communicative interactions; power and privilege are important factors; trust is critical in relationship.	Usually Quantitative and mixed methods; but using Qualitative methods for exploring dialectic relationship between the individual and the society is crucial to address cultural complexities and power issues.	Ethics involved is respect for cultural norms of interaction; beneficence involved is promotion of human rights and increase in social justice.

CLASSIFICATION OF RESEARCH (TYPES OF RESEARCH)

Table of Comparison: Qualitative Vs Quantitative Research

	QUALITATIVE	**QUANTITATIVE**

Basic framework	Objective is to explore phenomena	Objective is to confirm hypotheses about phenomena
	Style of eliciting and categorizing responses are flexible and iterative	Style of eliciting and categorizing responses to questions are rigid
	Methods used (in-depth interviews, focus groups, participant observation) are semi-structured	Methods used (questionnaires, surveys, structured observation) are highly structured
Analytical objectives	To describe variation	To quantify variation
	To describe and explain relationships	To predict causal relationships
	To describe individual experiences	To describe characteristics of a population
	To describe group norms	
Question format	Open-ended	Closed-ended
Nature of Data	Textual (obtained from audiotapes, videotapes, and field notes)	Numerical (obtained by assigning numerical values to responses)
Nature of study design	Some aspects (e.g., language, number of interview questions) are flexible	Stable throughout
	Researchers' questions are	Researchers' questions are not

	determined/influenced by participant responses	determined/ influenced by participant responses
	Data collection methods and research questions are adjusted according to what is learned	Data collection methods and research questions are subject to statistical assumptions/conditions

Table of Comparison: Basic Vs Applied Research

	BASIC RESEARCH	APPLIED RESEARCH
Aim	To expand existing scientific knowledge; make generalisations; formulate new theory	To solve specific practical problems; answer specific question; make conclusions; develop technology or technique
Nature	Theoretical	Practical
Scope	Universal	Limited
Examples	Study of human behaviour to make certain generalisations;	copy research, market research, evaluation research, study of social/ economic/political trends to draw conclusions

Table of Comparison: Deductive Vs. Inductive Approach

	Deductive approach	Inductive approach
Research strategy	Quantitative	Qualitative
Process Direction	Top to bottom General to the particular	Bottom to top Particular to the general

Focus	on validating theory; and testing hypotheses	on understanding dynamics; and gauging strengths
	on 'Mean' behaviour	on individual behaviour
	on constructing most likely future	on constructing alterative futures
Type of reasoning	objective	subjective
	To obtain causation	To obtain meaning
Type of question	Pre-specified; outcome oriented	Open-ended; process oriented
Type of analysis	Numerical estimation; Statistical inference; (also, Qualitative comparative analysis)	Narrative description; Constant comparison; (also, Exploratory data analysis)
Advantages	Allows quantitative measurement and explaining of causal relationships between concepts and variables	Allows working with a whole lot of probabilities
	Possibility to generalize research findings to a certain extent	Possibility of fuelling further research
Disadvantages	Limited scope of creativity	Limited scope
	Not flexible	Inaccurate inferences
Preferred when	Literature is abundant	Literature is scarce

	Time is limited	There’s no shortage of time

1. EXPLORATORY RESEARCH

It is conducted with the aim of exploring certain questions. So, the data analysis may not resolve the perceived problem or provide conclusive answers. It basically aims at exploring new problem areas which haven’t been tried before. This exploratory process, however, serves to lay the foundation for more conclusive data collection and research.

2. EXPLANATORY RESEARCH

It is undertaken to understand and explain the impact caused by changes introduced in the existing standard procedures; so, it is also called causal research. The most popular method of casual research is by conducting experiments.

3. DESCRIPTIVE RESEARCH

It describes a situation, subject, behaviour, or phenomenon. It focuses on expanding knowledge on current issues through a process of data collection. Descriptive studies are used to describe the behaviour of a sample population. In a descriptive study, only one variable is required to conduct the study.

4. EXPERIMENTAL/CAUSAL RESEARCH

It strictly adheres to a scientific research design. It investigates a hypothesis through experiments in a controlled environment where a variable can be manipulated by the researcher against variables that can be measured, calculated and compared. Participants in an experimental research are assigned their subject-groups randomly which means a participant has an equal probability of being placed

in the experimental or control group. Random assignment helps ensure that there are no systematic differences between the groups before the experiment so that when some condition is applied to the experimental and control groups, there isn't some predilection/preference/tendency in one group to respond differently from the other.

5. EX-POST FACTO RESEARCH

It examines how an independent variable or a quality that is present in participants prior to the study affects some dependent variable. An ex post facto design is considered quasi-experimental because the subjects are not randomly assigned to participants (unlike experimental studies). The participants are grouped on the basis of a particular characteristic or trait (variable) that is of interest to the researcher.

6. OBSERVATIONAL RESEARCH

It refers to a wide variety of non-experimental studies in which a variable or set of variables showing specific behaviour is systematically observed and the data, collected. It is nonexperimental as no variable is manipulated or controlled; and hence, causal conclusions cannot be made using this approach.

7. DEVELOPMENTAL RESEARCH

The purpose of developmental research is to assess changes over an extended period of time. For example, developmental research would be an ideal choice to assess the differences in academic and social development in low-income versus highincome neighbourhoods. It is most common when working with children as subjects for obvious reasons and can be undertaken using several methods: longitudinal, cross sectional, and cross sequential. It uses

methods such as longitudinal, cross sectional, and cross sequential studies.

8. ANALYTICAL RESEARCH

It involves an in-depth study to explain a complex phenomenon. It is primarily concerned with analyzing the facts or information already available to specify, interpret and establish cause and effect relationships and test the hypothesis. It employs the researcher's critical thinking skills to analyse the data (facts and information relative to the research being conducted); and to make a critical evaluation of the new knowledge/product or attempt to establish why a phenomenon exists in the way it does or how it came to be that way. Using analytical research, students, doctors and psychologists find out critical details to add new ideas to the material being produced.

9. HISTORICAL RESEARCH

It involves studying, understanding and interpreting past events with the purpose of gaining insights into or drawing conclusions from particular events, figures or social issues in history (past times); and establishing links between the old and the new. Interpretations are mainly done from documents, chronicles, journals and diaries. Primary sources, though preferred by historical researchers for being more accurate, are scarce. So, much of historical research bears the shortcoming of excessive reliance on secondary sources. Diaries, memoirs, posts and testimonies often carry a bias or an enhanced picture of the writer. Because of this likelihood, historical data is unacceptable at face value, and has to be examined for its authenticity and truthfulness.

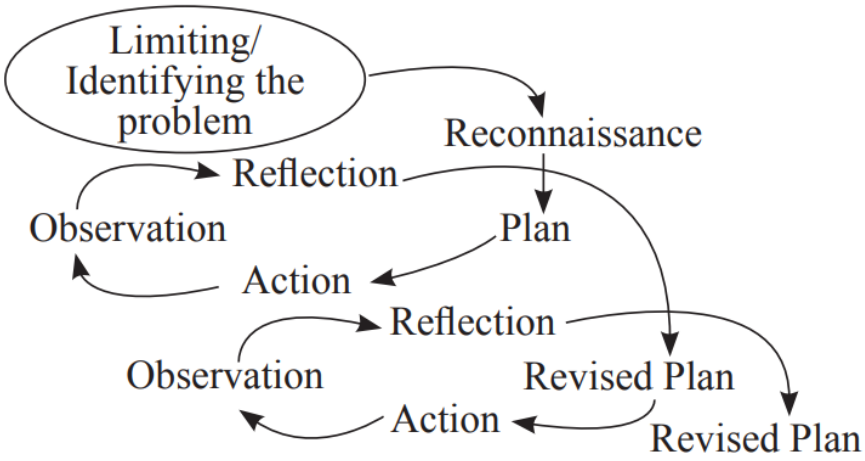
10. SOCIAL RESEARCH

It involves structural observation/study of social behaviour by collecting information about people and societies. Different socio-economic groups think and act differently. Different aspects of human behaviour need to be studied to understand their thoughts and dynamics of the social world. Social research may be employed to gauge new market trends, to introduce specific products/services/features catering to specific needs of the people, to upgrade old technology, etc.

11. ACTION RESEARCH

It comprises either a research process aimed at implementing required action to solve an immediate problem; or, a reflective spiral of research, action, evaluation, and revision/repetition of the steps for progressive problem solving.

The steps can be shown in a spiral as follows:



12. CLINICAL RESEARCH

Clinical research involves clinical trials and other research protocols performed on real people (volunteers participating in studies) to test the efficacy and/or safeness of a new drug, prevention strategy, or screening test. Clinical research is undertaken with the approval of doctors, administrators, ethicists and people representatives.

Participants are informed about the risks involved and asked to sign the consent form before they are accepted into a clinical trial.

13. PHENOMENOLOGY

Phenomenology focuses on experiences, events and occurrences with disregard or minimum regard for the external and physical reality. Phenomenology, also known as non-positivism, is a variation of interpretivism along with other variations such as hermeneutics, symbolic interactionism and others.

14. ETHNOGRAPHY

Ethnography is the scientific description of a particular human society, its peoples and cultures, with their customs, practices and diversities through participatory, analytical and comparative field studies.

15. GROUNDED THEORY

Grounded theory begins with no pre-existing theory, hypothesis, or expectation of findings. It only describes the topic of study and facilitates a theory to emerge directly from the data, which implies the theory is grounded in the data. The researcher selects individual cases on theory and purpose, (not randomly), collects and analyses data simultaneously, develops adequate theoretical conceptualisations of findings and allows findings and conceptualisations to grow together and cross-fertilise.

8. Methods of Research

RESEARCH METHODS AND DATA COLLECTION METHODS/TOOLS/INSTRUMENTS

I. FIELD STUDIES

Field studies collect authentic/unconventional data for a specific purpose via face-to-face interviews, surveys, or direct observation. Therefore, it is considered as an initial form of research not valid for generalisation. The process starts with identifying the data/ phenomena to observe so that a hypothesis or theory to explain certain occurrence(s) related to the specified group or phenomena can be formulated. The observations are then scaled/classified to ascertain what to use (and disregard the rest) and rank them on importance. Data analysis to resolve the research or to accept/ reject the hypothesis follows next.

II. SOCIOMETRY

This is a qualitative research method for evaluating/measuring social relationships and dynamics. Sociometry traditionally involves conducting a sociometric test on a group to collect and analyse data which will reveal the social dynamics prevailing within. Sociometric test, developed by Moreno and his associates, is a questionnaire seeking the preference of each member of a group to partner/associate with another member for some purpose/ activity.

III. CASE STUDY

This is an observational method of research especially used in social science, psychology, anthropology and ecology to evaluate/ test theoretical models by applying/using them on real people and in real world situations. A case study is an in-depth examination of an individual; or a social unit (community, cult, tribe, etc.) or event (a geographical shift, natural calamity, etc.). A case study in Psychology involves a clinical analysis and description of an individual with a rare/unusual condition/disorder; or, damage to a specific part/area/region of the brain.

IV. CASE CONTROL STUDIES

Case control studies (or case–referent studies) identify and compare two defined groups—one with the outcome/disease and the other without – on the basis of some supposed causal attribute or risk factor. They are retrospective in nature, surveying/ reviewing/observing the past course of events or period of time to make their assessments. The purpose of a case-control study is to investigate whether there is a statistically significant difference between the groups in their rates of exposure to a defined risk factor.

V. COHORT STUDIES

Cohort in terms of a research study refers to a defined set of people observed over a definite period of time. A Cohort study, generally used in medical and social sciences is a(n) observation/ survey to estimate the incidence rate, relative

risk or absolute risk of a disease in a certain population. The study usually observes two groups— exposed and not exposed— to assess which one develops the disease. The main outcome measure in cohort studies is a risk ratio/relative risk (RR).

VI. SURVEY

Survey, traditionally, was a quantitative method of collecting data from a pre-defined sample population of respondents, who were asked questions relevant to the study/subject with the intention of generalizing the results to a larger population. Today, surveys are a critical source of qualitative data also, providing insights into every field from government and academia to businesses and media.

Models of survey design

i. Longitudinal studies

ii. Cross-sectional studies

iii. Co relational studies

Models of survey data collection

i. Face-to-face surveys

ii. Telephone surveys

iii. Paper and pencil surveys (self-administered)

iv. Online surveys (self-administered)

VII. LONGITUDINAL STUDIES

Longitudinal studies observe, and collect data repeatedly from, the same set of subjects over an extended period of time (months, years, decades) with the aim of assessing the changes developed. In a longitudinal cohort study, the same individuals are observed over the study period. Cohort studies are common in medicine, psychology and sociology. The greatest disadvantage of longitudinal research is the length of time.

VIII. CROSS SECTIONAL STUDIES

One way to reduce the amount of time and the rate of mortality in a developmental study is to assess different age groups simultaneously rather than using the same age group over an extended period of time. A cross sectional study does the same. It can test the same theory for the same time. It is based on the assumption that the differences between the age groups represent natural development and a longitudinal study would have produced similar results.

IX. CROSS SEQUENTIAL STUDIES

Cross sequential studies combine the longitudinal and cross sectional methods in order to shorten the length of the research as well as minimize developmental assumptions.

X. CORRELATIONAL STUDIES

Correlational studies involve a non-experimental research method aimed at finding statistical relation between two sets of variables with no influence from any extraneous variable.

Correlation can be positive, negative or neutral as determined by a Regression analysis.

XI. OBSERVATION

Observations can be done directly or indirectly with or without the awareness of the subject. Data collection may be done by continuous observation or alternatively, in preset durations as per the requirements of the study.

XII. QUESTIONNAIRE

A questionnaire may have open-ended or close-ended questions or a combination of the two. While closed-ended questions usually provide quantitative data; open-ended questions seek qualitative data and allow respondents to elaborate their thoughts and ideas. A questionnaire may not necessarily be conducted in the form of a survey, but a survey invariably consists of a questionnaire.

XIII. INTERVIEW

Interview involves obtrusive questioning in a personal face to face social interaction to generate usable data. The researcher often records interviews or saves a transcript to be analyzed later. Questions in an interview may be closed-ended (providing respondents with a fixed set of responses to choose from), or open-ended (allowing people to express what they think in their own words). The interviewer must maintain ethical standards with respect to the vulnerability of the respondent(s) and the sensitivity of the topic undertaken.

9. Steps of Research

PROCESS/ STEPS OF RESEARCH

STEP 1: FORMULATION OF RESEARCH PROBLEM & OBJECTIVES

- Research problem is selected on the bases of the interest and aptitude of the researcher, the relevance and manageability/ attainability of the study, the availability of data, and ethical issues involved.
- The researcher zeroes in on a broad area that generates their interest and separating its subareas, selects the one focus area on which they would want to take up research.
- Then they scan the selected area to identify problems/gaps therein.
- Then they list all the questions that they would want to seek answers to.
- From those research questions, they formulate the general and specific objectives for which they are to take up research (mentioning the proposed benefits of the research)
- Then they narrow down the research questions and corresponding objectives to an attainable target and formulate their research problem.
- Researchers usually also identify, at this stage itself, the specific population they would conduct the research on, so that suitable subjects/respondents may later be selected.

STEP 2: CRITICAL LITERATURE REVIEW

A literature review involves surveying and scanning of books, journals, scholarly articles, and all other sources of information related to the research idea in order to know, and explain in the thesis/paper, how the literature survey relates to the research question and how the research fits within a larger field of study.

5. It traces the informed progression of the field, including major debates and concludes with identification of existing gaps and proposal to fill those with new/additional research.
6. It identifies areas of prior scholarship to prevent duplication of effort.

STEP 3: FORMULATION OF HYPOTHESIS

A hypothesis is a concrete verifiable prediction for a specific situation/event/phenomenon. It is a speculation or theory formulated on insufficient evidence that is taken up for experimentation/ verification/ testing so as to be proven true or false It is constructed as a statement of expected results that serves an exploratory purpose in empirical/quantitative research; provides a conceptual framework in qualitative research; and suggests guidelines to address problems that are still in a formative phase in applied research. The Purpose of a Hypothesis is to define in an experiment the relationship between the independent variable (the cause) which can be controlled /manipulated; and the dependent

variable which isthe measurable outcome effected by the former.

Characteristics of Hypothesis:

1. Itshould be very specific, which meansthe conceptsshould be explicitly defined so asto leave no ambiguity about what would constitute the empirical evidence or what would indicate the concept on the plane of reality.

2. It should be relevant/ related/ oriented to a body of theory which can be verified, supported, corrected or refuted by the research. In other words, it should explain the theoretic rationale or theoretical gains of testing the hypothesis.

3. It should be empirically testable, which means, it should enable logical deduction/ /inference which can be tested by observation in the field.

4. It should be able to predict an outcome.

STEP 4: PREPARING RESEARCH DESIGN

The research design is prepared after the hypothesis has been formulated and before the process of data collection is started. It is the blueprint of the complete process of the research based on its objectives and outlaysthe overall framework of the procedures to be followed to answer the research questions. It describes the scope of the study and states the approach/strategy as well as the type

(experimental, survey, correlation, semi-experimental, review, etc.) of research. It lists the objectives of the research as well as the benefits it will have. It gives the framework of correlation between the variables and specifies what sampling methods and sample size would be used; what types of data would be collected, from what sources or using what instruments/tools; and, what statistics and technique(s) of data analysis would be employed.At the same time, it explains why all of these specifics have been chosen over the others. It also briefs about the time available and the costs involved for each stage of the research. The name of a research design usually corresponds with the kind of research undertaken.

Characteristics of Research Design

There are four key characteristics of research design:
Neutrality: The result outcome predicted in a research design should be free from any bias.

Reliability: If a particular research is conducted on a regular basis, itshould give similar results every time. Only then would it be reliable. So, a research design should inform how the research questions would ensure the consistency of obtained results and therefore, reliability.

Validity: The research design must show how the research instrument/tool, e.g., questionnaire, would be developed to give valid results.

Generalization: The research will be able to give a generalisable result/conclusion.

STEP 5: DETERMINING SAMPLE DESIGN

Sampling refers to taking sample (representative part of a whole) of some population/subjects for a study. Researchers look to obtain information/data pertinent to their study through a survey of a selected sample of a population or universe of interest.

Sample design: It is the framework or road map of the proposed process of sampling, i.e., selecting a survey sample, and has a bearing on several other important aspects of the investigation/ observation. Sampling design describes three aspects of sampling— the frame, the size and the technique/method that would be employed forsampling based on random or non-random selection.

Sampling Techniques/methods:

Sampling techniques may be based either on probability or nonprobability of every individual being selected

I. Non-probability sampling– does not give all the individuals in the population equal chances of being selected.

Some such techniques are as follows:

Convenience Sampling– Selecting samples that are accessible to the researcher or easy to collect.

Consecutive sampling– Selecting all accessible subjects making the sample a better representation of the entire population.

Judgmental Sampling or purposive sampling–selecting with the belief that some subjects are more suitable than other individuals for the purpose.

Snowball Sampling– selecting a subject who is asked to identify another potential subject meeting the research criteria (Snowball sample is hardly representative of the population).

Quota Sampling– Selecting sample that ensures equal or proportionate representation of subjects per trait considered as basis of the quota for a given sample size.

Dimensional Sampling (an extension of quota sampling)–

The researcher takes into account several characteristics (e.g. gender, income, residence and education) and ensures that there is at least one person in the study representing each of the chosen characteristics.

II. Probability/sampling– on the other hand, utilizes some form of random selection method that ensures that the different units in the population have equal probabilities of being chosen. These are:

Simple Random Sampling– Drawing a name out of a lot, or using computers for generating random numbers. Stratified

Random Sampling– Randomly selecting from smaller group divisions of a large population that usually don't overlap but represent the entire population together.

Cluster random sampling– Randomly selecting participants from selects areas (i.e. cities or counties) when they are geographically spread out.

Systematic Sampling– Randomly selecting every "nth" individual to be a part of the sample according to a random starting point and a fixed periodic interval.

WRITING RESEARCH PROPOSAL

Once the research design and sampling design are finalised, it is time for the researcher to write and submit the research proposal. It is a document that informsthe concerned people about the specifics of the proposed study. It may be written for the purpose of obtaining an academic degree (MA Dissertation OR PhD thesis); to solicit funding for the research project; or to carry out market research for corporate houses.

A research proposal encapsulates

- Need for the study/ Gap in existing knowledge it will address
- Time and scope of the study
- List of Benefits and beneficiaries of the study
- Type(s) of data, methods of data collection and data analysis

• Help/facilities and funds sought

• Profile and credentials ofthe proposers ofthe research study

• Assurance of addressing ethical issues

STEP 6: DEVELOPING DATA COLLECTION INSTRUMENT & COLLECTING DATA

Purpose of Data in a research study:

Data collection forms a major part of the research process. Data is collected in any research study for the following purposes:

1. To represent verifiable/testable facts about the variables in the hypothesis/predicted result

2. To be analysed to determine consistency with the predicted outcome

3. To enable support of Null hypothesis if consistency with predicted outcome is established

4. To enable rejection of hypothesis if not consistent with the predicted result

Bias in clinical research

Type of Bias	How to Avoid it
I. Bias before study	
(i) Preferential study design	Select validated methods; define risk and outcome

	objectively; standardize data collection
(ii) Sample Selection bias	Select samples from the same general population to avoid confounding results
(iii) Channeling bias	Use rigorous criteria to assign cohorts
II. Bias during study	
(i) Interviewer bias	Standardize interviewer's interaction with the respondent
(ii) Chronology bias	Use prospective studies; avoid using historic controls

(iii) Recall bias	Use objective data sources; conduct prospective studies
(iv) Transfer bias	Make contingency plan in study design (prior to the study) for lost/transferred patients
(v) Exposure Misclassification	Define exposure in study design itself; avoid using proxies of exposure
(vi) Outcome Misclassification	Use objective/ validated diagnostic methods or measures as primary outcome

(vii) Performance bias	Minimize variability in clinical method with cluster stratification
(viii) Confounding	Control unknown confounders with randomization; and known confounders with case control design/ randomization (during preparation of study design) or regression (during data analysis)
III. Bias after study	
Citation bias	Register the study with an accepted clinical trials registry and ensure no similar study exists or is underway

An **index** is a way of obtaining one summarized score/response from a variety of questions/ statements representing a belief, feeling, or attitude.

A **scale** is used to categorize and/or quantify variables. Measurement scales measure quantitative/numerical data for statistical analysis; or, qualitative data like level of intensity of the variable (attitude, etc.) in terms of the respondent's agreement or disagreement with the topical statement.

1. Statistical Measurement Scales

Statistical data can be measured on any of the following four scales: nominal, ordinal, interval or ratio.

i. Nominal scale is the system of naming or labelling events by assigning number symbols. Random numbers are assigned to members of a playing team to name/identify them on a nominalscale. Such numbers have no quantitative value and cannot be added, subtracted, multiplied, or divided. Nor can they be compared or used for calculating average, mean, mode, etc. The only possible arithmetic operation with a nominal scale is counting of members in a group. Nominal data are, thus, counted data.

ii. Ordinal scale places events/objects in an order and is used in research relating to qualitative phenomena. e.g., the rank of a student in a particular grade is determined using an ordinal scale. Ordinal scales only rank items from one extreme to another and ordinal measures have no absolute values. Therefore, the actual differences between the pairs of adjacent ranks may not be equal.

iii. Interval scale has intervals earmarked in terms of some criterion that has been established as a basis for making the units equal/comparable. In reality, the units are equal only on the basis of assumptions on which the rule is based. Interval scales can have an arbitrary zero, but not an absolute zero.

iv. Ratio scale does have an absolute zero of measurement, though it may not be too precise. Absolute

zero of length as well as time is conceivable. e.g., the zero mark on a metre scale indicatesthe complete absence oflength/breadth/height. The number of ‘absent’marksin a monthly attendance sheet, the number of typographical errorsin a manuscript, etc., can be represented on ratio scales. Each of these measurements has an absolute zero; and all typo errors and all‘absent’marks can be assumed to be equal in significance.

2. Self Rating Scales

Self-rating scales include survey questions that offer multiple answer options ranging between the two extreme attitudes, e.g., from ‘completely agree’ to ‘not agree at all’; OR from ‘extremely likely’ to ‘not at all likely.’ They typically include a moderate median or a neutral midpoint. Researchers choose different rating scales depending on the nature and requirement of their research study.

Following are the self-rating scales researchers use.

A. Graphic Rating Scale

B. Itemized Rating Scales (6 types)

   a. Likert Scale

   b. Semantic Differential/ Thurston Scales

   c. Stapel’s Scale

   d. Multi Dimensional Scaling

   e. Guttman Scales/Scalogram scale

f. The Q Sort technique

Qualitative Data	Quantitative Data
Associated with details/description	Associated with numbers
Can only be observed and not accurately measured	Can be accurately measured and statistically analyzed
Usable as segregated, well-defined groups or categories	Usable in numerical form
Ex. appearance, colour, flavour, etc.	Ex. temperature, time, height, weight, etc.

Methods of Collecting Quantitative Data

Quantitative data has value in the form of numbers. Each dataset is quantifiable information having a unique numerical value associated to it. This quantity/number is verifiable and can be used for mathematical/ statistical calculations and analysis, based on which, research questions can be answered and real-life decisions can be made.

Measuring of various parameters is convenient and controllable with quantitative data as mathematical derivation can easily be done. Quantitative data is usually collected for statistical analysis using experiments, surveys, polls or questionnaires administered to a selected sample section of a population. The results must be applicable/ generalisable to the entire population.

Types of Quantitative Data

i. Number count equated with entities

ii. Physical measurement of objects/entities.

iii. Conversion ofsensory measurements(e.g., electromagnetic information) of parameters into numerical data.

iv. Future projection of data using algorithms and other mathematical analysis tools.

v. Quantification of qualitative entities on numerical scales

Advantages of Quantitative Data

i. Allows in-depth research since quantitative data can be statistically analyzed.

ii. Numerical nature of quantitative data minimises personal bias.

iii. Results are extremely accurate as data obtained are objective in nature.

Disadvantages of Quantitative Data

i. Making conclusions is difficult as quantitative data is not descriptive and yields restricted information.

ii. As it relies on the types of questions selected, it is prone to researcher's bias in results. So, the researcher must frame questions in strict accordance with the objective(s) of research.

Methods of Collecting Qualitative Data

Qualitative data doesn't include numbers in its definition of traits of an object or group of objects unlike quantitative data.

Data collection for qualitative research usually involves direct interaction with individual respondents/ subjects on a one to one basis or individuals in a group setting. The main methods for collecting qualitative data are surveys (in the form of observation, questionnaire, schedules, focus group and interview), ethnography, case studies, narrative, phenomenology and grounded theory.

Types of Qualitative Data

Qualitative data is information about abstract qualities, such as beauty, colour, complexion, softness, gender, etc., that cannot really be measured. However, such data can be placed in categories according to codes of common properties, etc. Therefore, qualitative data is also called categorical data. e. g. a student's performance feedback on fluency, intonation, throw of words, clarity in pronunciation without giving a grade to the child, this is considered as an example of qualitative data.

Advantages of Qualitative Data

i. The information collected is richer having the respondent's/ subject's attitudes, feelings, behaviours and deep insight into the phenomenon under study.

ii. Encourages respondents/ subjects to elaborate their responses; and open up new topic areas not initially considered by the researcher.

Disadvantages of Qualitative Data

i. Qualitative data collection methods are time consuming and expensive; therefore, data is usually collected from a smaller sample.

ii. As sample sizes are smaller, they may not be a correct represent the population.

STEP 7: DATA ANALYSIS

A **parameter** is any computed number describing an entire population, such as average, percentage or proportion. Parameter inference refers to computing the statistic as an estimate of the parameter. The population mean μ and the population proportion p are two different population parameters.

A **statistic** is a number computed from the data observed in a random sample of a population without requiring the use of any unknown parameters, such as a sample mean. Statistical inference refers to deriving information from the sample of the population.

Validity is the extent to which a concept, test, measurement or conclusion, accurately provides/yields what it is primarily supposed to; or, corresponds accurately to the real world.

Reliability is the degree to which the result of a measurement, calculation, or specification obtained by administering the same test twice over a period of time to a group of individuals can be depended on to produce stable and consistent results.

Methods of analyzing quantitative data (collected in surveys):

1. Cross-tabulation: Thisis one of the most preferred and widely used quantitative data analysis methods. It uses a basic tabular form to draw inferences by a comparison of different data-sets obtained in the research study. The data can be mutually exclusive or may have some correlation with each other.

2. Trend analysis: Thisis a statistical analysis method of looking at quantitative data that has been collected over a long period of time. This data analysis method comprises collecting feedback about data changes over time and aims to study the change effected in variables while one variable remains unchanged.

3. Max Diff analysis: This is a quantitative data analysis method used to gauge customer preferences for a particular product purchase and to determine, in the process, what parameters rank higher than the others. This method is very similar to conjoint analysis, given below, but is much easier to implement. However, the two can be interchangeably used.

4. Conjoint analysis: This is a similar quantitative data analysis method that analyzes what parameters work to clinch a purchasing decision. This method enables collection and analysis of advanced metrics which determine

parameters are the most important; and provide an in-depth understanding into purchasing decisions.

5. TURF analysis (Total Unduplicated Reach and Frequency Analysis): This is a quantitative data analysis methodology that examines the market reach of a product or service or a combination of the two. This method is used by organizations to understand the avenues through which their communication/ messages reach customers and prospective customers; and with what frequency. This helps researchers modify/update their market strategies.

6. Gap analysis: This is a quantitative data analysis method wherein side-by-side matrix is used to depict quantitative data so that the difference between expected performance and actual performance can be measured. So, this data analysis helps measure gaps in performance and expectation to bridge this gap.

7. SWOT analysis: This is a quantitative data analysis method of assigning numerical values to indicate strength, weaknesses, opportunities and threats of an organization/ product /service which help in understanding the whole scenario of the market competition so that effective business strategies could be devised.

8. Text analysis: This is an advanced statistical method where intelligent tools quantify qualitative and open-ended data into easily understandable data. So, this method is

used to convert the raw and unstructured survey data into a numerical structure that makes sense.

Methods of analyzing Qualitative data

1. Content analysis: Thisisthe process of categorizing verbal or behavioural data to classify,summarize and tabulate the data.

2. Narrative analysis: This is the process of reformulating respondents' narration taking into account the context and experiences of each respondent. It is, indeed, the revision/ interpretation of primary qualitative data by researcher.

3. Discourse analysis: This is the method of analysing all natural discourse in spoken form and all written text.

4. Grounded theory: This method of qualitative data analysis is initiated with an analysis of a single case to formulate a theory. Then, more cases are analysed to examine whether they contribute to the theory.

5. Framework analysis: This is an advanced method of analysis consisting of several stages such as familiarization, identifying a thematic framework, coding, charting, mapping and interpretation.

Techniques/Tools of Statistical Data Analysis

1. Correlation

Correlation is a statistical technique to obtain a summary of the relationship between pairs of variables which explains whether they are related; if they are, then how strongly. Take

the example of height and weight. One assumption is that taller people are heavier than shorter people; but, the relationship isn't alwaystrue. People of the same height may differ in body weight, and it is often observed that shorter one of a given pair is heavier than the taller one. However, the average weight of people 150 cm tall is less than the average weight of people160 cm tall whose average weight islessthan that of people 170 cm tall. Correlation analysis can show how much of the variation in peoples'weightsisrelated to their heights. An intelligent correlation analysis reveals the unsuspected correlations contained in the data and also identify the strongest correlation among the suspected ones. A correlation coefficient is a numerical measure of some type of statistical relationship existing between two variables. It is the main result of the process of correlation. It is denoted by r and ranges from -1 to +1. The closer r is to +1 or -1, the more closely the two variables are related, where +1 indicates the strongest possible agreement and −1 the strongest possible disagreement.

2. Frequency Distribution

Frequency distribution is the technique of organizing and summarizing the data collected from a survey in a tabular format. It consists in listing the qualitative or quantitative values of a variable in a data set and marking the frequency of occurrence of each value (number of times each value occurs). Frequency distribution is the basis of all statistical

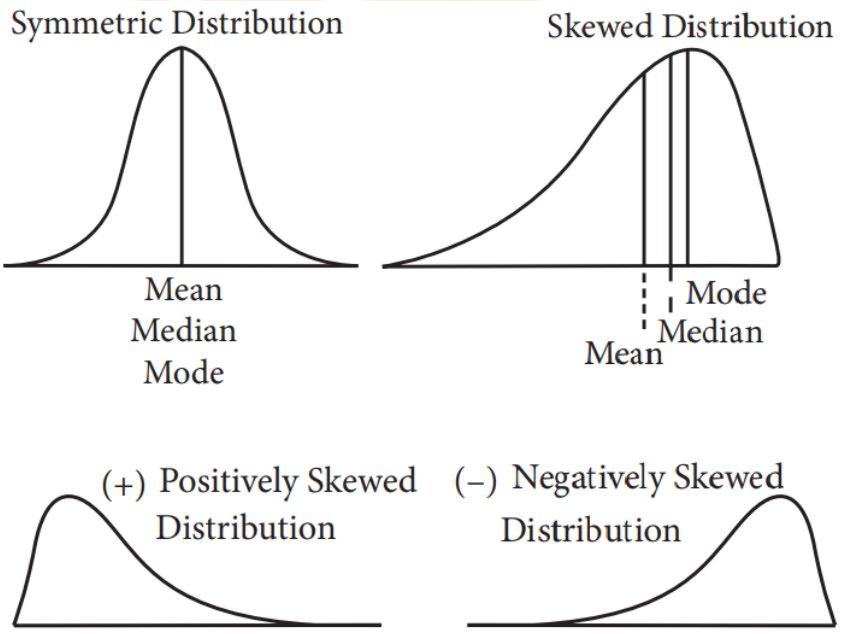
analysis and also forms the first step in analysis of survey data. The tabular representation makes it convenient to interpret the data and detect outliers or extreme values in the survey data set. Frequency distribution can be graphically represented as a curve.

A **normal distribution** is a bell-shaped frequency distribution curve. Most of the data values in a normal distribution cluster around the mean. The further a data point is from the mean, the less likely it is to occur. The center of a normal distribution is located at its peak.+ Normal distributions are symmetric (the right side of the central line is a mirror image of the leftside), unimodal (, and asymptotic (they approach but never touch the x-axis).; and the mean, median, and mode are all equal.

Standard deviation is a statistic that projects how closely clustered around their mean are the values in a data set as shown in the distribution curve. It is shown by means of a bell-shaped curve. When the values are bunched together, the bell curve is steep which means the standard deviation is small. When the values are spread apart, the bell curve is relatively flat, which indicates that the standard deviation is relatively large.

The standard normal distribution is that particular case of normal distribution when a normal random variable has a mean of zero and a standard deviation of one. The normal random variable of a standard normal distribution is called a standard score or a z score.

Skewness is asymmetry in a statistical distribution, in which the bell curve appears distorted or skewed either to the left or to the right. Skewness can be quantified to define the extent to which a distribution differs from a normal distribution.

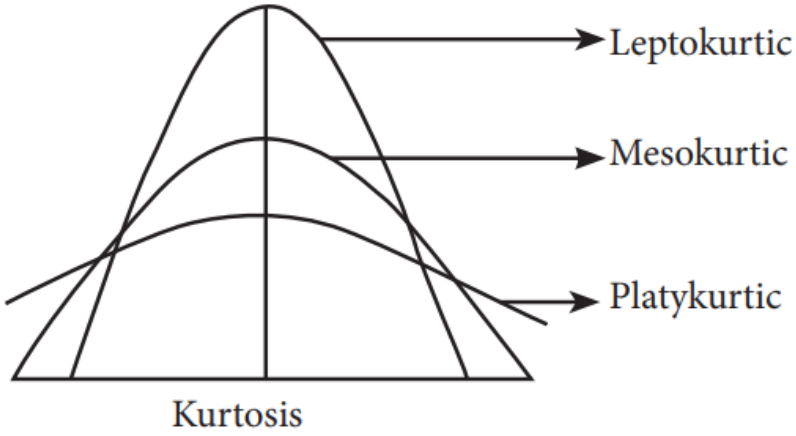


Kurtosis is the sharpness of the peak of a frequency-distribution curve, i.e., a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution.

Leptokurtic distributions are statistical distributions where there are extreme points along the X axis, resulting in a higher kurtosis than found in a normal distribution.

Mesokurtic distributions have a kurtosis of zero, matching that of the normal distribution, or normal curve, also known as a bell curve.

Platykurtic distributions have the peak of the curve comparatively flatter than that of normal distribution.



Kurtosis

4. Chi-square test

The chi-square test is a statistical procedure employed for examining the differences between variables of different categories in the same population. The chi-square distribution is the distribution of the sum of squared standard normal deviates. Chi Square distributions are positively skewed or skewed to the right, with the degree of skew decreasing with increasing degrees of freedom. As the degrees of freedom increase, the Chi Square distribution approaches a normal distribution.

5. f-test

An f-test is a statistical test to compare different statistical models fitting a data set sampled from a population in order to identify the one that fits best. It is performed on the basis of the F statistic. The F- statistic has an F-distribution under the null hypothesis. F-distribution is a skewed distribution of probabilities similar to a chi-squared distribution. But while the chi-squared

distribution deals with the degree of freedom with one set of variables, the F-distribution deals with multiple levels of events having different degrees of freedom. F-distribution is defined as the ratio between the two independent chi square variables that are divided by their respective degree of freedom.

6. t-test

A t-test is a parametric test which finds out if two sets of data are significantly different, how significant those differences are; and, if those differences (measured in means/averages) could have happened by chance. A t-distribution is a probability distribution in which the bell shape of a normal distribution has a heavier tail, because T-distributions have a greater chance for extreme values than normal distributions. The t-value is a ratio of the difference between the mean of the two sample sets (numerator value) and the difference that exists within the sample sets(the denominator).

7. z-test

A z-test is a statistical test that is performed to determine the probability of the new data being near the point for which a score was calculated. It is a statistical calculation to compare a sample mean with the defined population mean and is typically used in case of large samples (n > 30).

8. Regression analysis

Regression analysis is a predictive technique of identifying the variable(s) that have impact on a variable of interest and investigating the relationship between the target dependent variable and the predictor independent variable(s). Simple Regression involves single independent variable while Multiple Regression involves multiple independent variables.

9. Analysis of variance (ANOVA)

The main purpose of an ANOVA test is to check if two or more groups show variance, i.e., they differ from each other significantly in one or more characteristics in a regression study. Variance is the expected squared deviation of a random variable from its mean.

10. Discriminant Analysis

DiscriminantAnalysis aimsto obtain a set of prediction equations based on independent variables so as to use it to classify individuals. It works with a dual objective— to obtain predictive equations for grouping new individuals; and, to interpret those equations to better understand the correlation between the variables. It can be used to determine which predictor variables are related to the dependent variable and to predict the value of the dependent variable given certain values of the predictor variables. Discriminant analysis is very similar to multiple regression analysis in methodology, from variable selection to a residual analysisfor determining the accuracy ofthe discriminant equations.; however, discriminant analysis must have a discrete

dependent variable while regression analysis deals with a continuous dependent variable. Discriminant analysis is also related very closely to the one-way MANOVA. Only, the variablesstand reversed .The factor or classification variable in the MANOVA becomes the dependent variable in discriminant analysis and vice versa.

11. Structural equation modelling

It is a multivariate statistical analysis technique that is used to analyze structural relationships. Thistechnique isthe combination of factor analysis and multiple regression analysis, and it is used to analyze the structural relationship between measured variables and latent constructs.

12. Factor analysis

It is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. In an experiment, the factor (also called an independent variable) is an explanatory variable manipulated by the experimenter. Each factor has two or more levels (i.e., different values of the factor).

13. Cluster analysis

Cluster analysis(or classification analysis or numerical taxonomy) is a multivariate method of classifying a sample of subjects/ objects/cases into a number of different clusters on the basis of a

set of measured variables, such that similar subjects are placed in the same group.

STEP 8: HYPOTHESIS TESTING

Hypothesis testing in statistical analysis starts with the construction of two statements— the null hypothesis and the alternative hypothesis – and involves testing of the latter by proving the former false; or, making the decision whether the null hypothesis should be accepted or rejected. The null hypothesis is only rejected if its probability falls below a predetermined significance level, in which case the hypothesis being tested is said to have that level of significance.

Null Hypothesis (HO or H0):

It is what a researcher attempts to find evidence against in the hypothesis test. The null hypothesis is generally a hypothesis of 'no difference'.

Alternative hypothesis It is the obverse of the null hypothesis. It reflects that there will be an observed effect for the experiment and the observations are the result of a real effect.

P-value: It is the level of marginal significance within a statistical hypothesis test representing the probability of the occurrence of a given event. If the p-value is greater than alpha, the null hypothesis cannot be rejected.

Level of Significance (Alpha): It refers to the level of significance in which the null-hypothesis is accepted or rejected. Normally, a

significance level of 5% is taken for accepting or rejecting a hypothesis, since 100% accuracy is not possible. Random error or Chance error or chance variation is the inherent error in any predictive statistical model. It is defined as the difference between the predicted value of a variable (by the statistical model in question) and the actual value of the variable.

Type I error: It occurs when the null hypothesis is rejected, although the hypothesis was true.

Type II error: It occurs when the null hypothesis is accepted, although the hypothesis was false.

STEP 9: GENERALISATIONS AND INTERPRETATIONS OF CONCLUSIONS

Generalization involves informed reasoning to draw broad inferences from particular observations. It is standard in quantitative research, but is controversial in qualitative research. Most qualitative studies aim not to generalize, but to provide a rich, contextualized understanding of some aspect of human experience through the intensive study of particular cases. Yet, both qualitative and quantitative researchers emphasize on generalization in relation to knowledge claims in environments where evidence for improving practice is held in high esteem. Issues relating to generalization are, however, often ignored or misrepresented by both groups of researchers.

STEP 10: REPORT PREPARATION OR THESIS/ ARTICLE/ PAPER WRITING

The report of a research study carried out for finding answers to research question(s)is prepared in different ways in accordance with the purpose, the target audience/reader and the presentation arena. While a Paper is meant to be presented before the participants in a Workshop, Seminar, Symposium or Conference, and, an Article is published in a peer-reviewed academic journal; a Thesis or Dissertation is published in pursuit of an academic degree. A position paper is an essay that presents an arguable opinion about an issue – typically that of the author or some specified entity. Position papers are published in academia, in politics, in law and other domains.

10. Thesis and Article Writing

THESIS AND ARTICLE WRITING

Parts/Sections in a Research Report

1. Title/Cover Page
2. Certificate of Originality
3. Acknowledgements
4. Abstract
5. Introduction
6. Scope/ Limitations of the Study
7. Literature Review
8. Research Design
9. Data Analysis and interpretation
10. Conclusion
11. References/ Bibliography
12. Appendices

Formats and Styles of Referencing

I. APA Manual style

Example: (i) Carroll, J.P. (1966). Some neglected relationships in reading and language. Elementary English, 43, 511-582

II. Chicago Manual style

REFERENCES:

Format: Author(s) Last name, First name. “Title of Article.” Journal Title Volume, Issue no. (Year): pages.

FOOTNOTES:

Format: #. Author(s) First name Last name, “Title of Article,” Journal Title Volume, Issue no. (Year): Page.

III. MLA style

Example:

Kushkova, Anna. “At the Center of the Table.” Russian Studies in History, vol. 50, no.1, 2011, pp. 44-96

For book

Example:

Shelley, Mary. Frankenstein. Lackington, Hughes, Harding, Mavor & Jones, 1818.

IV. AMA Style

Example:

Economopoulos KJ, Brockmeier SF. Rotator cuff tears in overhead athletes. Clin Sports Med. 2012;31(4):675-692.

For Journals

For book

Example:

Laccetti MS, Kazanowski MK. Pain Management. Sudbury, MA: Jones and Bartlett Publishers; 2009.

V. Harvard Referencing style

For journals

More than three authors: Battisti, C, Fanelli, G, Bertolino, S, Luiselli, L, Amori, G & Gippoliti, S 2018, 'Non-native invasive species as paradoxical ecosystem services in urban conservation education', Web Ecology, vol. 18, no. 1, pp. 37-40.

For books

More than three authors: Puccio, GJ, Cabra, JF & Schwagler, N 2018, Organizational creativity: a practical guide for innovators & entrepreneurs, Sage, Thousand Oaks, CA.

Some Latin abbreviations often used in referencing

ibid.

This is the abbreviation of the Latin word ibidem (which means "in the same place") and, therefore, always has a period after it. When two consecutive notes from the same place are cited, ibid. is used for the reference of the second note. The purpose is to avoid repetition of the whole note all over again and direct the reader to the same source that was referred to for the preceding note. In the Chicago style, works can be cited in either footnotes or endnotes as per the author's choice. The APA style doesn't use ibid. while the MLA style guide has begun to discourage the use of Latin abbreviations like ibid.

op.cit.

This is the abbreviation of the Latin phrase opere citato, meaning "in the work already cited". It refers to the work/source in a previous reference, though not the immediately preceding one;

and, is preceded by the author's name and followed by the page number (s). The publication date is also included if more than one work by the same author is included in the references.

loc.cit.

This is an abbreviation of the Latin phrase loco citato, meaning 'in the place cited'. It refers to the work in the immediately preceding reference, and can be used instead of ibid. when all the citation details (including page numbers) are identical.

et al.

This is an abbreviation of the Latin phrase et alii, meaning 'and others'. When a work has more than two authors it is the common practice to name the first author only and follow it with et al to indicate that there are other authors, too.

Impact factor of a journal

The impact factor (IF) of a journal or journal impact factor of an academic journal is used as an indicator of the importance of a journal in its field. It was first introduced by Eugene Garfield, the founder of the Institute for Scientific Information. The impact factor (IF) of a journal is a measure of the frequency with which the average article in the journal has been cited in a particular year. It is a scientometric index that reflects the yearly average number of citations that recent articles published in the given journal received.

It is calculated for a two-year period by dividing the number of times articles contained in the journal were cited by the total number of 'citable' articles published in those two years.

Calculation of 2019 IF of a journal

A = the number of times articles published in 2017 and 2018 were cited by indexed journals during 2019.

B = the total number of “citable items” published in 2017 and 2018.

A/B = 2019 impact factor

The IF of a journal is not associated to the factors like quality of peer review process and quality of content of the journal. Journal which publishes more review articles will get highest IFs.

h-index of an academic

The h-index, or Hirsch index, measures the impact of a particular researcher/scientist/scholar rather than a journal. The h-index attempts to measure both the research productivity and citation impact of the publications of the researcher. It gives the highest number (h) of publications of a researcher that received h or more citations each, indicating that their other publications did not receive more than h citations each. For example, an h-index of 10 for a researcher means they published 10 papers, each of which was cited by others at least 10 times. The h-index of a particular researcher/scientist/scholar may be very different in different databases because databases index different journals and cover different years.

g-index of an academic

The g-index looks at overall record of a researcher’s publications and is calculated on the basis of the distribution of citations

received. For a given set of articles ranked in decreasing order of the number of citations that they received, the g-index is the unique largest number such that the top g articles received together at least g2 citations. So, a g-index of 10 means that at least 10 published articles of the researcher/ academic have together received at least 102 or 100 citations by others.

A comparison

Unlike the h-index, g-index can be generated if even a small number of articles have received citations. Suppose, an academic with 20 papers, 16 of which have no citations while the remaining five have respectively 300, 65, 30, 5 and 2 citations (together 402, i.e., at least 202 or 400) would have a g-index of 20, but an h-index of 5 (i.e., 5 papers with at least 5 citations each).

RESEARCH PRESENTATION

Conference

A conference is a formal meeting where participants confer on specific topics or exchange their views on topics. It is a prearranged meeting where delegates hold consultation and discussion on a number of topics. It features keynote addresses and presentations and includes multiple breakout sessions. A conference need not be academic in nature and it can take place in different fields, such as educational institutions, sports, trade and commerce, journalism, medicine, research, and so on.

Symposium

A symposium is a small scale conference where the number of delegates is smaller, but it is held in a prestigious academic setting, generally leading venues in their respective fields. Here, experts in their respective fields present their talk/opinions on a chosen topic and the usual discussions follow. The chief characteristic of a symposium is that it covers a single topic or subject and all the lectures given by experts are completed in a single day. Conference and symposium are similar events where speakers come together and give their opinions on a chosen subject.

Seminar

A seminar is a form of academic instruction, offered either at a university or a commercial or professional organization. Its basic purpose is to bring together small groups for recurring meetings that focus on a chosen/particular subject each time, require everyone present to actively participate. The concepts and techniques are presented and discussed through a combination of visual materials, interactive equipment and demonstrations. Participants in a seminar receive some souvenir relating to the lecture.

Workshop

A Workshop has all the elements of the seminar, but, differs in one characteristic feature. It essentially involves “hand-on-practice” or laboratory work which is designed to reinforce, practice, imprint and implement the actual concept or technique taught/ learnt through the preceding lecture and demonstration process.

Webinar/ Web Conference

A Webinar/Web Conference is a seminar/conference held exclusively on the internet and attended by an online audience. It makes audio and video feeds of speaker(s), often including PowerPoint slides running in sync with the presentation, available to participants via a PC, Mac, tablet or smart phone. Used effectively, it is a powerful form of one-to-many communication/interaction enabling a presenter to reach a large and specific group of online viewers from a single location. Smart tools, such as Survey, Poll, Test, Chat, Ask a question, etc., are essential to channelize interaction as participants may be large in numbers.

Colloquium

A colloquium is an informal academic meeting or seminar of a dual nature where an address is followed by a question and answer session/forum. Each of the participating scholars/researchers delivers a talk/lecture on a different topic and follows it up by responding to questions based on it.

The basic purpose of a colloquium is to address contemporary academic concerns common to a particular group such as scientists, students doing a certain course, or educators by discussing and debating on cutting-edge research studies which can be followed by meetings to formulate policies. It is different from a regular conference or workshop in two ways. While it has a strictly academic theme, a conference/workshop is not necessarily of an academic nature with presenters not necessarily having any academic affiliation. Secondly, a conference/workshop

usually follows a formal agenda while a colloquium is aimed at analyzing and discussing a particular topic and garnering the views of others on it.

Congress

A Congress is a formal association/gathering/assembly/conference of representatives of interest groups pertaining to a particular field. It is typically held once a year to discuss or decide on a specific question; is attended by leaders in that field; and, features a series of invited talks. It functions to highlight the achievements and notable results in that field.

Convention/ Meeting

A convention is a formal deliberative gathering/ assembly of mandated delegates who meet at an arranged place and time in order to discuss or engage in some issues of common interest. It features keynote speakers, displays, and other information and activities of interest to the participants who work to reach a formal agreement, contract, pact, treaty or supplement to such on a specific conduct for generations.

11. Application of ICT in Research

APPLICATION OF ICT IN RESEARCH

Academic publishing

It has taken on a new dimension with the advent of Information and Communication Technology (ICT). The processes as well as products/fruits of academic research and scholarship now enjoy a worldwide reach/connectivity and easy availability of resources in the electronic format. Academic/Research work, usually published in the form of academic journal article, book or thesis/dissertation, has grown manifold with e-publishing on the worldwide web. Most established academic outfits have their own journals and other publication, and publish work from several distinct/specialized fields or subfields. **Literature Search**, **Content Search, Literature Tracking** has become a cakewalk with the exhaustive repository of academic output made available on the worldwide web. Academic materials and research output, not formally published by academic concerns and distribution channels but merely printed up or posted on the Internet by others is termed grey literature.

Quantitative/Qualitative Data Collection

Data collection and monitoring and evaluation (M&E) efforts take a great deal of time and methodical planning and implementation. Traditionally performed with paper and pen, these tasks were prone to error, difficult to conduct on a large scale, and high in

transaction costs. Information and communication technology (ICT) tools, including hardware like mobile phones and tablets, applications with the capacity to create digital surveys, and software that allows users to upload data to storage facilities in real-time, have reduced the conventional challenges associated with remote data collection and M&E. Surveys, Interviews, and Questionnaires can easily and speedily be carried out online using ICT applications.

Big Data Analytics

The vast repository of data is generated from modern information systems and digital technologies such as Internet of Things and cloud computing applied in several research disciplines like agriculture, healthcare and manufacturing. Analysis of these massive data requires huge efforts at multiple levels to extract knowledge for decision making. Big data analytics refers to the complex process of analysing such large and varied data sets, or big data, to unearth variable patterns, correlations, trends, etc., that can help researchers to make inferences, arrive at conclusions and make informed decisions. ICT applications enable big data analytics.

Peer Review

Most scientific and scholarly journals, and quite a few academic and scholarly books, go through a peer review or refereeing by experts in the concerned field to certify their quality before

publication. ICT has sped up this process considerably by eliminating the logistic hassles like postal delays.

RESEARCH PUBLICATIONS' AVAILABILITY ON THE WORLDWIDEWEB

The early 1990s, saw the beginning of licensing of electronic resources, particularly journals. And soon, open access via the Internet, became an important trend, particularly with respect to journals in the sciences. In open access publishing, the publisher makes a journal article available on the worldwide web for free. Authors may also avail themselves of open access self-archiving by making a copy of their published articles available on the web. Thanks to ICT, every academic/research organization, university, library, etc., today houses its repository of thesis/dissertation on its official portal and makes it available to all for free or sometimes, for a fee. Many online publishing organizations through their public portals provide authors around the world a global platform to showcase their valuable research work.

INFLIBNET

Information and Library Network (INFLIBNET) Centre is an autonomous Inter-University Centre (IUC) of the University Grants Commission (UGC) of India headquartered at Gujarat University Campus, Ahmedabad. In April 1988, the University Grant Commission (UGC) constituted a committee under the chairmanship of Prof. Yash Pal, to work out the details of a university information library networking system. The report of

this working group was published in December 1988 containing a project proposal for the establishment and development of an information and library network. Finally, in April 1991, INFLIBNET was initiated by the UGC.

Started as a project under the IUCAA, it became an independent Inter-University Centre in June 1996. INFLIBNET is a computer communication network of libraries and information centres of universities, institutions of national importance, Research and Development Institutions, bibliographical information centres, etc. It uses state-of-the-art technologies for optimising the capability in information handling and service and creating the infrastructure for the sharing of library and information resources and services among the academic and research institutions. INFLIBNET is set out to be a major player in promoting scholarly communication among academicians and researchers in India.

The main **resources** of INFLIBNET are:

(i) University catalogue of documents/periodicals/theses

(ii) Research & Development Library Catalogue of the collection of NISCAIR and NASSDOC.

(iii) The computerized catalogue of the National Library of Kolkata.
(iv) Indigenous Databases of discipline oriented information centres such as Machine tools, Food technology, Leather technology, Drugs, Aeronautics

The main functions/activities of INFLIBNET are:

(i) INFLIBNET is a cooperative venture; its resources depend on the users/participants. The development of SOUL

(ii) The INFLIBNET Library plays a vital role in the collection development and dissemination of scientific and technical information to meet the present and future needs of the government.

(iii) The introduction of library management software, SOUL is likely to give more revenue to INFLIBNET and provide justification for more and more libraries to join it. Under Prime Minister's special package to NE India, SOUL packages are given free of cost to those libraries which are under 2F or 12B of UGC. Delivery of SOUL package is done through the UGC Regional office. The SOUL 2.0 was launched in 2009.

(iv) INFLIBNET Centre develops a digital institutional repository using DSpace software. It hosts INFLIBNET's Press and Media related documents, INFLIBNET's Annual Reports, INFLIBNET's Convention Proceedings, INFLIBNET's Special Seminar, etc.

(iii) It takes an active role in Electronic Submission of Theses and Dissertations (ETD), a joint venture with UGC, making it mandatory to submit the electronic copy of a thesis whenever the research scholars submit their thesis to the respective university or institutions for the PhD degree.

(iv) It launched an open source utility primarily focused on libraries, where one needs to convert CCF data to MARC21 format.

(v) It has standardized MARC – II as bibliographic standard for data capturing.

(vi) It holds Seminars, Conferences, Workshops and Training. It conducted Convention on Automation of Libraries in Education and Research Institutions (CALIBER) and Promotion of Library Automation and Networking in North Eastern Region (PLANNER) annually; and 2009 onwards, it has been conducting it every alternate year. It also conducts INFLIBNET Regional Training Programme on Library Automation (IRTPLA) and Attachment Training Programme for Practicing Librarians and Computer Professionals of North Eastern Region.

(vii) It maintains four online mailing lists besides its "INFLIBNET Centre Blog" that provides news and announcement related to the INFLIBNET.

e-consortium of INFILIBNET

e-ShodhSindhu is a Consortium for Higher Education Electronic Resources that provides access to e-resources to Universities, Colleges and Centrally Funded Technical Institutions in INDIA. It is an Initiative by MHRD, Govt of India being Executed by INFLIBNET Centre.

Shodh Suddhi is a programme introduced by MHRD, Govt of India on the recommendation of Sub-Committee, National Steering Committee (NSC) of eShodh Sindhu. It provides access to Plagiarism Detection Software (PDS) to all universities/ Institutions in India since Sept 1, 2019.

N-list or National Library and Information Services Infrastructure for Scholarly Content is an Initiative of Ministry of Human Resource Development (MHRD) under the National Mission on Education through ICT (NME-ICT) now funded by UGC. The consortium subscribes to all the major e-journal and e-book across the world resources for the use of students, researchers and faculty from colleges and other beneficiary institutions through server(s) installed at the INFLIBNET Centre colleges. It is the college component of eShodh Sindhu.

Open-access initiatives of INFLIBNET

Shodhganga is a digital reservoir of all Indian theses. The UGC Notification (Minimum Standards & Procedure for Award of M.Phil. / Ph.D Degree, Regulation, 2016) dated 5th May 2016 mandates submission of electronic version of theses and dissertations by the researchers in universities with an aim to facilitate open access to Indian theses and dissertations to the academic community world-wide. Online availability of electronic theses through centrally-maintained digital repositories, not only ensures easy access and archiving of Indian doctoral theses but also aims to help in raising the standard and quality of research;

and overcome the serious problem of duplication and/ or poor quality of research resulting from the “poor visibility” of research output.

Shodhgangotri is the repository of Indian Research in Progress details (Synopses/Research Proposals for PhD programme). **IR@INFLIBNET** is the Institutional repository of INFLIBNET Centre housing articles published in all conventional proceedings of INFLIBNET Centre, training material, press clippings, newsletters, etc.

Vidya-mitra is an online learning portal for all the e-content projects developed under the NME-ICT (National Mission on Education through Information and Communication Technology), MHRD. The portal provides facility to search and browse all hosted content wherein a learner can easily access the desired material including audio/video learning material, textual material, multimedia-enriched materials etc. through a single interface. Moreover, features of faceted search, usage statistics, project-wise access, My-Space are incorporated in this portal.

Vidwan is the premier database of profiles of scientists / researchers and other faculty members working at leading academic institutions and other R & D organisation involved in teaching and research in India. It provides important information about expert’s background, contact address, experience, scholarly publications, skills and accomplishments, researcher identity, etc. The database is developed and maintained by INFLIBNET with

financial support from the National Mission on Education through ICT (NME-ICT). The database is instrumental in selection of panels of experts for various committees, taskforce, established by the Ministries / Govt. establishments for monitoring and evaluation purposes.

IndCat is a free online Union Catalogue of Books, Theses and Serials of major university/institute libraries in India. It contains bibliographic information, location and holdings of Books, Theses and Serials. It provides the records in standard bibliographic formats, i.e., MARC, MARCXML. It covers all major subjects, i.e. Psychology, Statistics, Political Science, Economics, Law, Public Administration, Education, Commerce, Linguistics, Mathematics, Astronomy, Physics, Chemistry, Biology, Life Sciences, Botany, Zoology, Medicine, Engineering, Agriculture, Management, Architecture, Sports, Literature, History, Computer Science etc. A Web-based interface is designed to provide easy access to the merged catalogues. The IndCat is a major source of bibliographic information that can be used for Inter-Library Loan, Collections Development as well as for Copy Cataloguing and Retro-Conversion of bibliographic records.

GOVERNMENT SPONSORING OF RESEARCH

The Prime Minister's Research Fellowship (PMRF) scheme is aimed at attracting the talent pool of the country to doctoral (Ph.D.) programmes of Indian Institute of Science (IISc), Indian Institutes of Science Education & Research (IISERs), Indian

Institutes of Technology (IITs) and Central Universities (which are among the top 100 National Institutional Ranking Framework, NIRF ranked universities) for carrying out research in cutting edge science and technology domains, with focus on national priorities.

Central Government runs various scholarships and funding schemes for Research & Development and innovation in the following Departments and Agencies:

(i) All India Council for Technical Education (AICTE)

(ii) Department of science and Technology

(iii) Council of Scientific and Industrial Research (CSIR)

(iv) Defence Research and Development Organisation (DRDO)

(v) Department of Atomic Energy (DAE)

(vi) Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoepathy (AYUSH)

(vii) Department of Biotechnology (DBT)

(viii) Ministry of Coal (MOC)

(ix) Ministry of Earth Sciences (MoES)

(x) Department of Scientific and Industrial Research (DSIR)

(xi) Indian Council of Medical Research (ICMR)

(xii) India Meteorological Department (IMD)

(xiii) Indian Space Research Organisation (ISRO)Indian Space Research Organisation (ISRO)

(xiv) Department of Electronics & Information Technology (DeitY)

(xv) Ministry of Environment, Forest and Climate Change

(xvi) Ministry of New and Renewable Energy

(xvii)Ministry of Power

(xviii)Ministry of Social Justice & Empowerment (MOSJE)

(xix) Ministry of Water Resources, River Development & Ganga Rejuvenation

(xx) Ministry of Petroleum & Natural Gas

(xxi) University Grants Commission (UGC)

12. Research Ethics

RESEARCH ETHICS

Research Ethics has three major concerns:

(i) to protect human participants from harm;

(ii) to ensure that the research process serves the interests of individuals, groups and/or society as a whole; and

(iii) to examine specific research activities and projects for their ethical soundness in terms of management of risk, protection of confidentiality and the process of informed consent.

Research ethics are based on three fundamental principles:

1. **Respect for Persons:**

(i) People should be treated as autonomous which means researchers must respect that individuals should make their own informed decisions about whether to participate in research.

(ii) People with diminished autonomy should be protected, which means those like young children or the infirm and/or invalid, who may not be capable of making fully informed decisions on their own about how to act or what to receive should be protected and only be included in research under specific circumstances.

2. **Beneficence:**

(i) No harm should be caused, which means the purpose of research should never be to hurt anyone or to extract information at the expense of other people.

(ii) Benefits for participants should be maximized and risks to participants, minimized.

3. **Justice:**

Fairness and equitability should be ensured in terms of

(i) recruitment of participants

(ii)choice of location to conduct the study

(iii) questions asked being relevant to the participating communities.

ETHICAL ISSUES PERTAINING TO THE RESEARCH PROCESS

1. **Bias** or lopsided presentation of facts/truth; it undermines objectivity.

2. **Inappropriate** research methodology or biased sample, method and procedure; it distorts findings

3. **Falsification** or inaccurate representation of research process, instrument, data and findings

4. **Fabrication** or creating spurious data without actual test/ survey.

5. **Incorrect reporting** or manipulating results

6. **Authorship impropriety** in terms of improper assignment of credit (including/excluding author/s at will) or submission of multi-authored paper without knowledge of all the authors

7. **Duplicacy** or submitting same study in more than one journal

8. **Partial publication** or publishing parts of same study in different journals

9. **Peer review impropriety** or compromising confidentiality and protection of intellectual property in a peer review by revealing identities/names of reviewer/author (both should be unaware of each other's names in a Peer review)

10. **Plagiarism** or appropriating someone else's ideas, materials, products as one's own; plagiarism can be Intra-corpal (one copying from another in the same submission; extracorpal (copying from an external source like book, journal, internet); or auto plagiarism (citing one's own work without reference/acknowledgement)

11. **Compromising reliability & validity of research** by using faulty measuring instrument that doesn't measure what it is intended to measure.

MEASURES TO ENSURE ETHICAL RESEARCH

1. Following professional code of ethics to maintain professional standards and to be accountable and responsible

2. Following state and Central Government regulations that enable protection and advancement of individuals as well as society

3. Seeking informed consent and voluntary participation
4. Screening to select participants tolerant to risks involved
5. Carrying out pilot studies with follow-up diagnostic as a precautionary measure against potential harm
6. Preparing protective research design to estimate probability, severity and duration of risk/harm
7. Taking outside review of research proposal to minimize risk
8. Allowing participants withdrawal from study at any stage of research
9. Maintaining honesty and integrity in every aspect of research
10. Exercising extreme care to avoid errors and discrimination.