INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Class: M.Sc.

Subject : Research Methodology

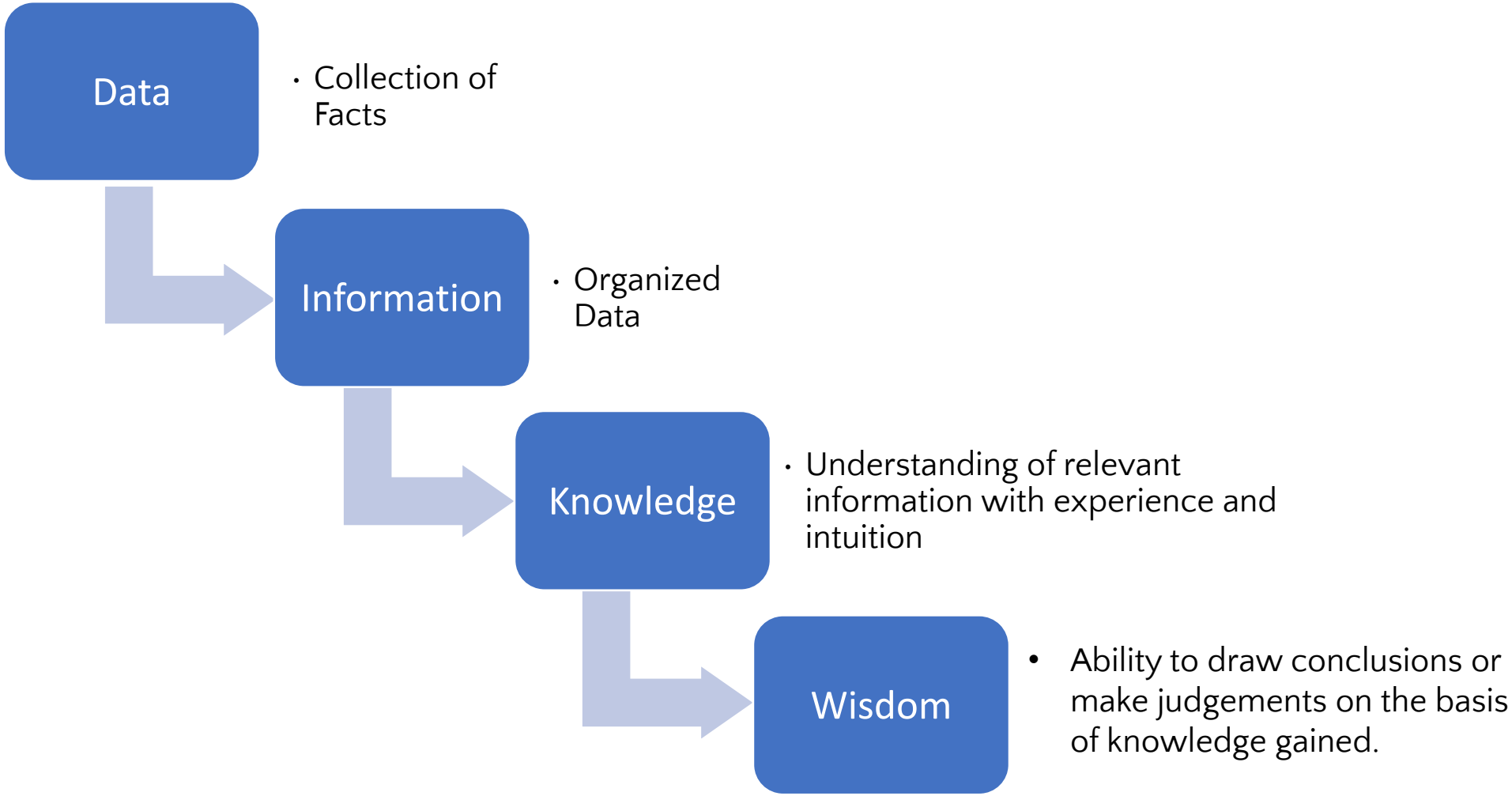
Chapter: Unit 1 Chapter 1

Chapter Name: Introduction to Research Methodology

Motivation

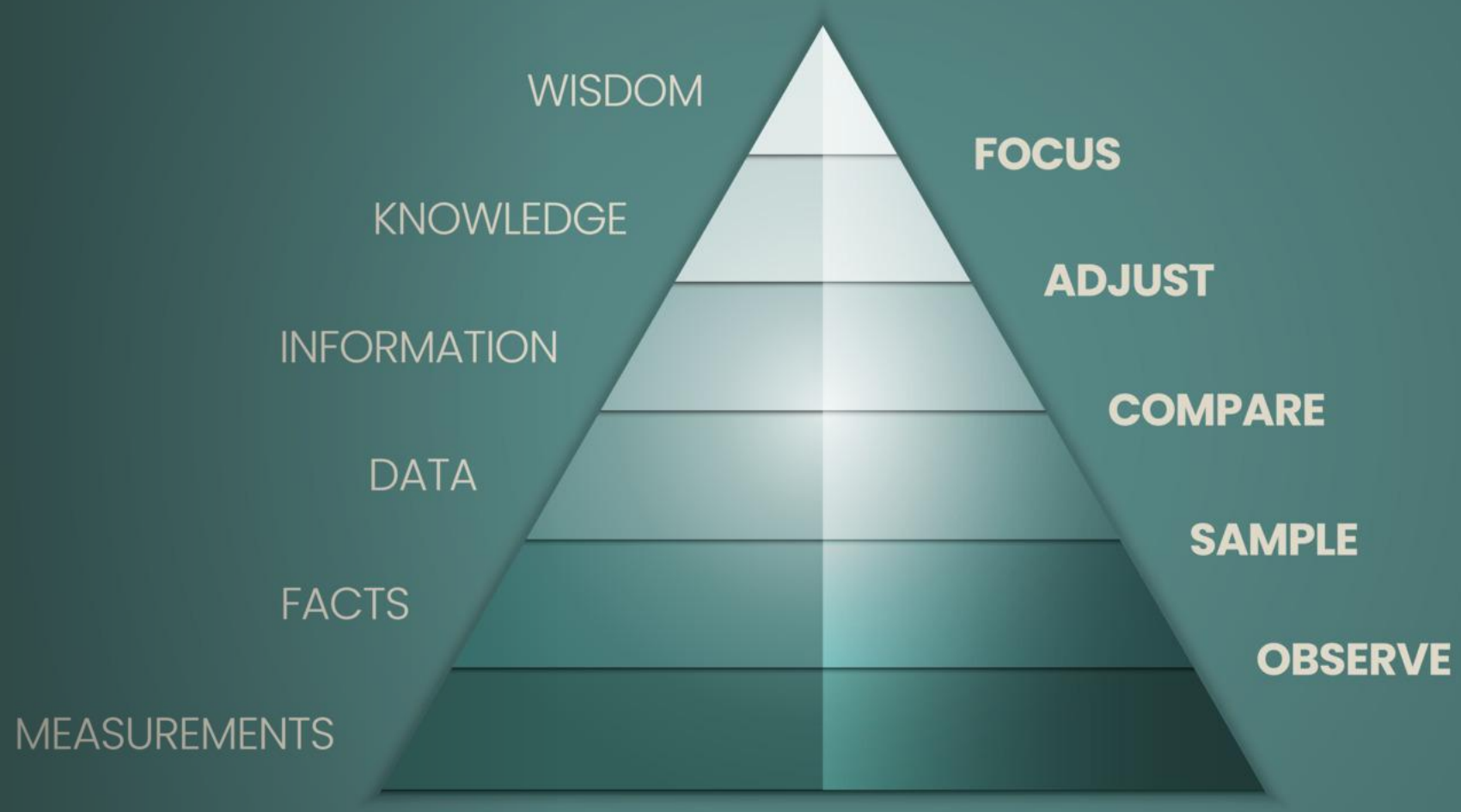
To quench the thirst for knowledge, human beings constantly carry out search and re-search.

1 DIKW Model


Data
Collection of Facts
Information
Organized Data
Knowledge
Understanding of relevant information with experience and intuition
Wisdom
Ability to draw conclusions or make judgements on the basis of knowledge gained.

DIKW

KNOWLEDGE MANAGEMENT MODEL



2 Research

What is a Research?

A careful, systematic and scientific enquiry or,

investigation to seek pertinent information about any domain of knowledge pertaining to some phenomenon, individual, event, subject or object.

Research is a movement from the unknown to the known.

2.1 Research Methodology

Research methodology is a way of explaining how a researcher intends to carry out their research. It's a logical, systematic plan to resolve a research problem.

A methodology details a researcher's approach to the research to ensure reliable, valid results that address their aims and objectives.

It encompasses what data they're going to collect and where from, as well as how it's being collected and analyzed.

2.2 Research Methods

The methods and techniques used by a researcher while carrying out the research work,

- such as theoretical procedures, schemes, steps, algorithms, numerical techniques, experimental set-up, statistical methods.

- to observe and record the facts and further to analyze them to arrive at conclusions.

They are essentially planned, scientific and value-neutral (without personal bias).

2.3 Significance of Research

1

Advances Knowledge

Research expands our understanding of the world, leading to groundbreaking discoveries and innovations that shape our future

2

Informs Decision-Making

Rigorous research provides evidence-based insights, enabling informed decision-making and effective problem-solving.

3

Drives Progress

Research is the driving force behind societal, technological, and medical advancements that improve our quality of life.

2.4 Qualities of Researchers

- Analytical mind
- Systematic
- Intelligence
- Curiosity
- Quick thinker
- Commitment
- Communication skills – Oral and written
- Sympathetic
- Ability to stay calm

2.5 Examples of Research

Let's say a hospital performs quantitative research to analyze how efficient the hospital's operations are. The hospital conducts a survey to collect data from both doctors and patients.

The survey included questions such as:

- ✔ How much time does the doctor take for one patient? (Options: <10 mins, 10 to 30 mins, 30–50 mins, and 50+ mins).
- ✔ How often does a patient come into the hospital? (1 time, 2–4 times, 4–8 times, and 8+ times)
- ✔ Rate your (patient) satisfaction level (scale of 1 to 10).

Method:

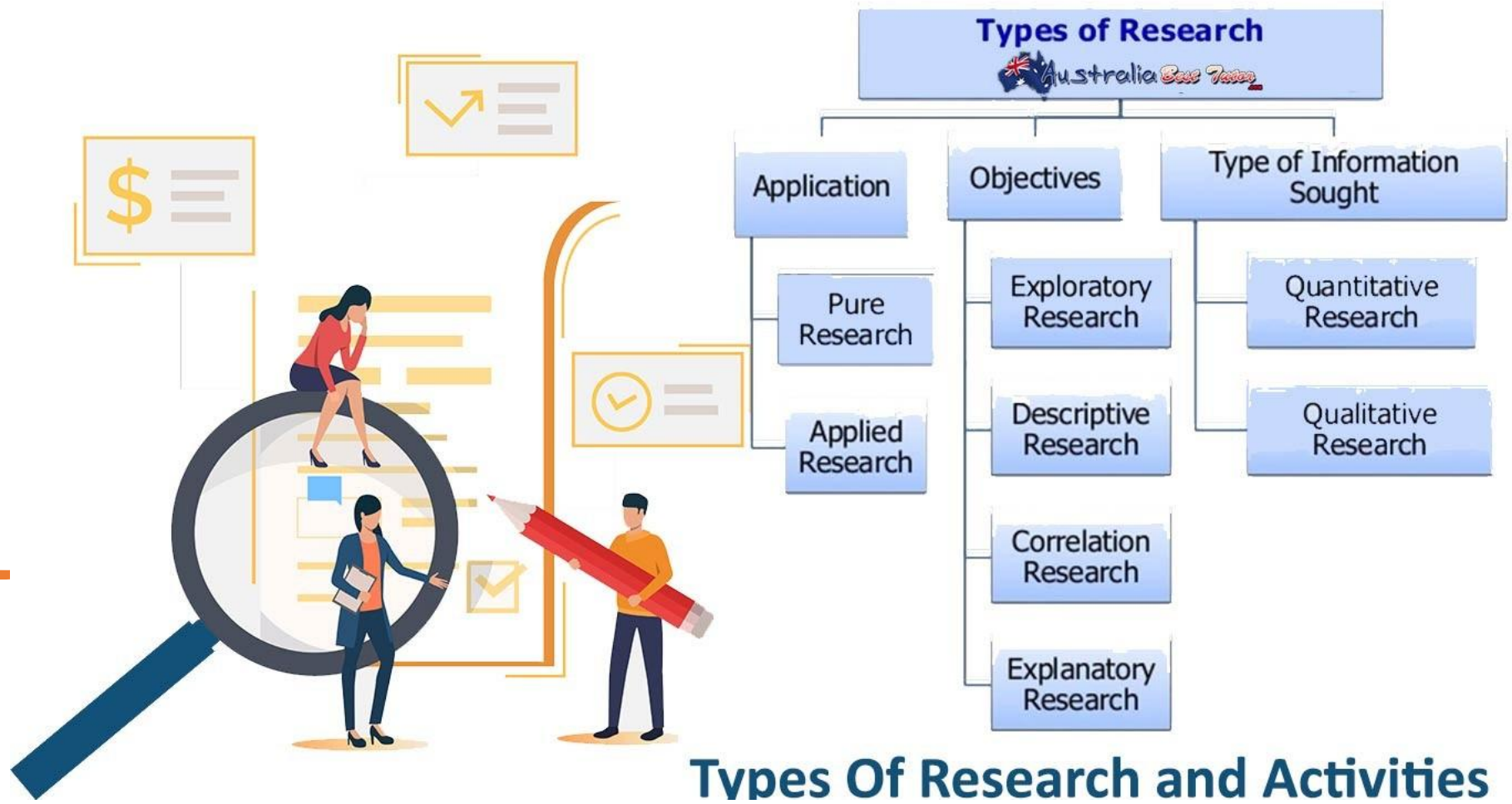
After getting all the information, the researcher determines the option that most people choose. For example, if 6 out of 10 people picked "<10 mins" for "How long the doctor spends with each patient?", that's what they consider as the average.

2.5 Examples of Research

Result: The following are the key results from the survey.

- → The average time spent by a doctor for one patient varies from 10-30 mins.
- → The average number of patient visits per month is 3.
- → The average satisfaction of patients following doctor consultations is 7.

Types of Research



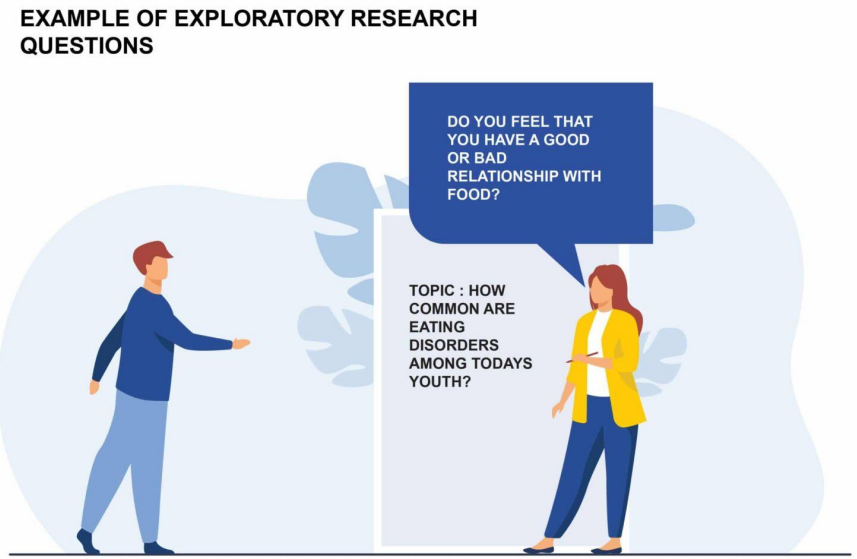
3.1 Exploratory Research

Exploratory research is used for the preliminary investigation of a subject that is not yet well understood or sufficiently researched. It serves to establish a frame of reference and a hypothesis from which an in-depth study can be developed that will enable conclusive results to be generated.

Because exploratory research is based on the study of little-studied phenomena, it relies less on theory and more on the collection of data to identify patterns that explain these phenomena.

It results into discovery of ideas, proposing some concept or identifying some problem.

For example, an investigation of the role social media in the perception of self-image.



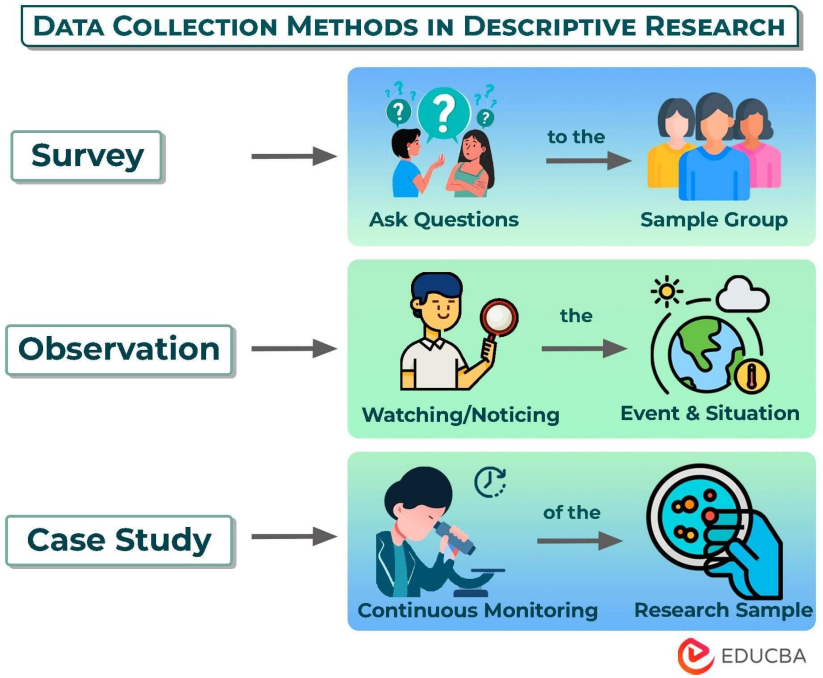
3.2 Descriptive Research

Descriptive research is a methodological approach that seeks to depict the characteristics of a phenomenon or subject under investigation..

Descriptive research design is a suitable option when the research objective is to discern characteristics, frequencies, trends, and categories without manipulating variables. It is therefore often employed in the *initial* stages of a study before progressing to more complex research designs.

Descriptive research design is widely employed across diverse fields, and its primary objective is to systematically observe and document all variables and conditions influencing the phenomenon..

A marketing team wants to understand the attitudes and behaviors of consumers towards a new product. They conduct a series of focus groups and use qualitative coding to identify common themes and patterns in the data. They also create visualizations such as word clouds to show the most frequently mentioned topics.



3.3 Explanatory Research

To establish or verify the nature of relationships between two or more characteristics or attributes of some phenomenon, subject, object, individual, or event.

It uses secondary research as a source of information, such as literature or published articles.

It allows the researcher to have a broad understanding of the topic and refine subsequent research questions to augment the study's conclusions.

Explanatory research can also be explained as a "cause and effect" model, investigating patterns and trends in existing data that haven't been previously investigated. For this reason, it is often considered a type of causal research.

For example, To assess the impacts of foreign direct investment on the levels of economic growth in a country.

	Exploratory	Descriptive	Causal
Objective:	Discover ideas and insights	Describe mkt. characteristics or functions	Determine cause and effect relationships
Characteristics:	• Flexible • Versatile • Often the front end of total research design	• Marked by prior formulation of specific hypotheses • Preplanned and structured design	• Manipulation of one or more independent variables • Control of other mediating variables
Methods:	• Expert surveys • Pilot surveys • Secondary Data (analyzed qualitatively) • Qualitative research	• Secondary Data (analyzed quantitatively) • Surveys • Panels • Observational and other data.	• Experiments

3.4 Applied Research

Applied research draws on theory to generate practical scientific knowledge, and its use is very common in STEM fields such as engineering, computer science and medicine.

The primary purpose of applied research is to generate new knowledge that can be used to solve real-world problems or improve the efficiency and effectiveness of existing products, technologies, or processes.

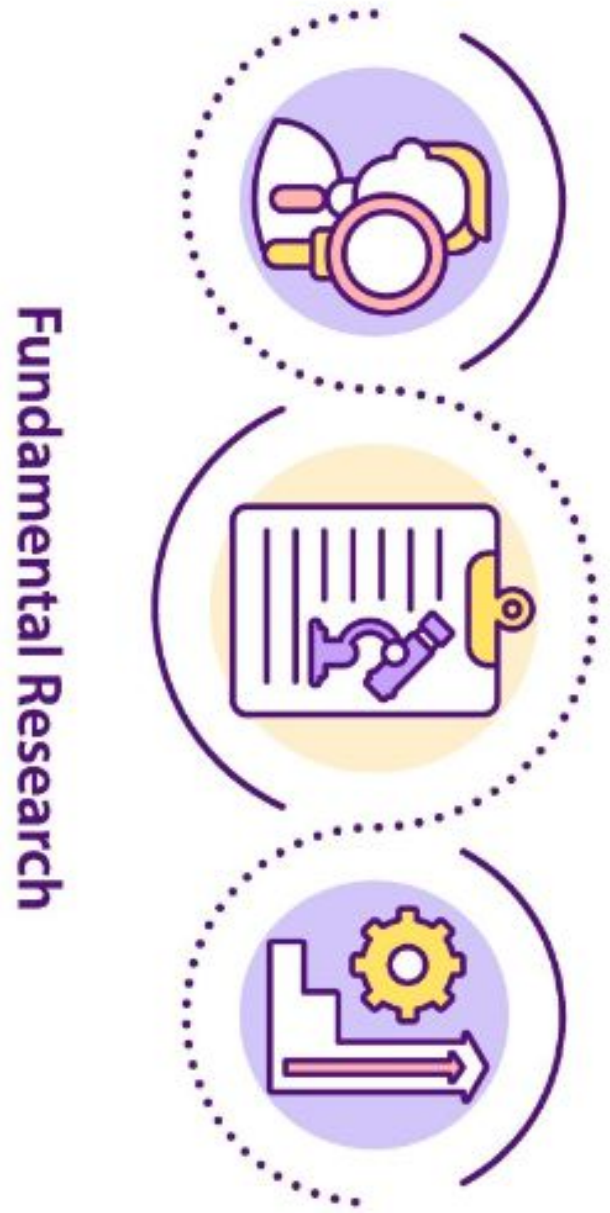
For example, market research, because by examining consumption patterns, strategies can be developed for the development of new products and marketing campaigns, etc.

3.5 Fundamental Research

Aims at gathering knowledge and generalizations and formulations of a theories or policies.

It is driven by curiosity and the desire to explore new frontiers of knowledge rather than by the need to solve a specific problem or to develop a new product.

Mathematicians conduct basic research to develop and explore new mathematical theories, such as number theory, topology, and geometry. This research can lead to new applications in fields such as computer science, physics, and engineering.



3.6 Qualitative Research

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

Qualitative research methods conclude "why" a particular theory exists along with "what" respondents/ observers have say to about it.

Eg: To research the culture of a large tech company, you decide to take an ethnographic approach.

One-on-one interview

Ethnographic research

Qualitative observation

Focus groups

3.7 Quantitative Research

Quantitative research study delves into a phenomena through quantitative data collection and using mathematical, statistical and computer-aided tools to measure them. This allows generalised conclusions to be projected over time.

Quantitative research methods broadly include questionnaires, structured observations, and experiments. It is used when researchers are interested in understanding data sets over time to identify patterns.

E.g. Unveiling the Power of Physical Exercise on Mental Well-being

Unlocking the correlation between physical exercise and mental health, this quantitative inquiry stands at the forefront of holistic wellness research.

Collect reliable and accurate data

Quick data collection

Wider scope of data analysis

Eliminate bias

3.7 Types of Quantitative Research

Non-Experimental Research

- Non-experimental research is the type of research that does not involve the manipulation of control or independent variable. In non-experimental research, researchers measure variables as they naturally occur without any further manipulation.
- This type of research is used when the researcher has no specific research question about a causal relationship between 2 different variables, and manipulation of the independent variable is impossible.

Experimental Research

- Experimental research is the type of research that uses a scientific approach towards manipulating one or more control variables of the research subject(s) and measuring the effect of this manipulation on the subject. It is known for the fact that it allows the manipulation of control variables.
- Experimental research is usually undertaken when the goal of the research is to trace cause-and-effect relationships between defined variables.

4 Research Process

Set of sequentially arranged activities necessary to carry out research effectively.

- Identifying the research problem
- Reviewing literature available
- Framing the research problem statement
- Preparing the research design
- Deciding the sample design
- Collecting the data
- Processing and analyzing the data
- Hypotheses Testing
- Generalizations and interpretation
- Writing the report or thesis

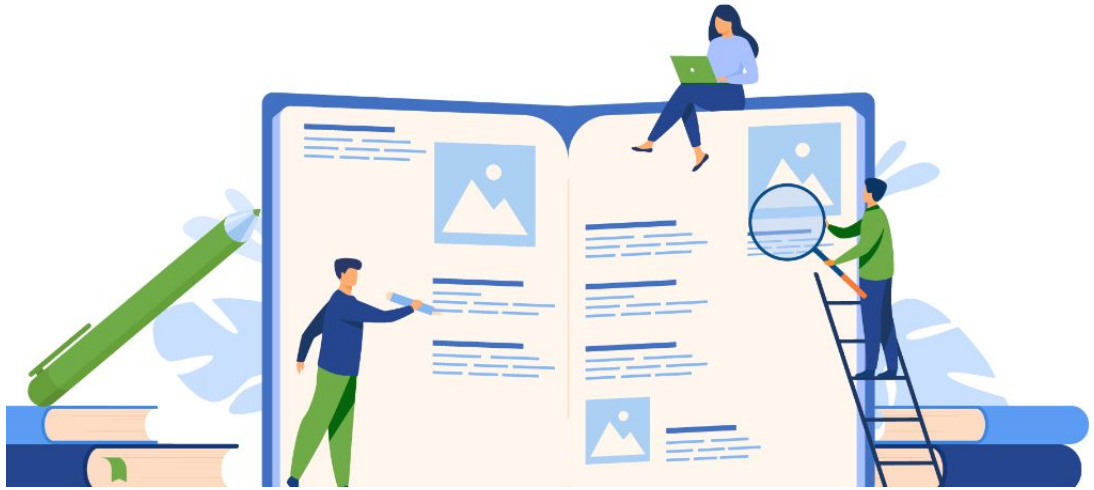
4.1 Research Process

1. IDENTIFYING THE RESEARCH PROBLEM

The first and foremost task in the entire process of scientific research is to identify a research problem. A well-identified problem will lead the researcher to accomplish all-important phases of the research process, from setting objectives to selecting the research methodology.

There should be a perceived discrepancy between “what it is” and “what it should have been.” This implies that there should be a difference between “what exists” and the “ideal or planned situation”;

4.2 Research Process



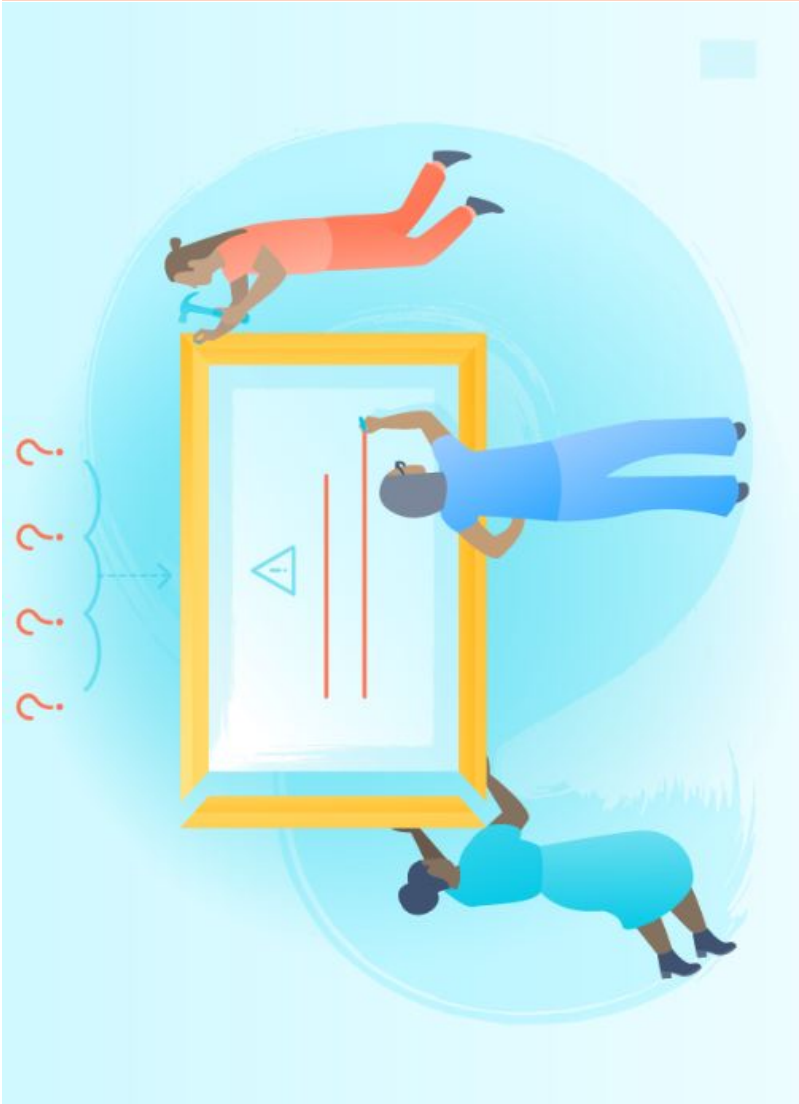
2. REVIEWING LITERATURE AVAILABLE

A review of relevant literature available is an integral part of the research process.

- It helps the researcher to understand
- ✔ What concepts and theories are relevant to his area of investigation.
- ✔ The specific aspects to his area of investigation that have not been researched so far.
- It enables the researcher to become familiar with the methodology followed by others.
- It avoids duplication of the work that has been done in the recent past.

A confident and expert researcher is more crucial in questioning the others' methodology, the choice of the data, and the quality of the inferences drawn from the study results.

4.3 Research Process



3. FRAMING RESEARCH PROBLEM STATEMENT

After extensive literature survey, researcher should state in clear terms the objectives of research – what he is looking for and scope and framework of his study.

An objective will precisely say what should be researched, delineate the type of information that should be collected, and provide a framework for the scope of the study. A well-formulated, testable research hypothesis is the best expression of a research objective.

Hypothesis is an unproven statement or a proposition which can be put to a test to determine its validity.

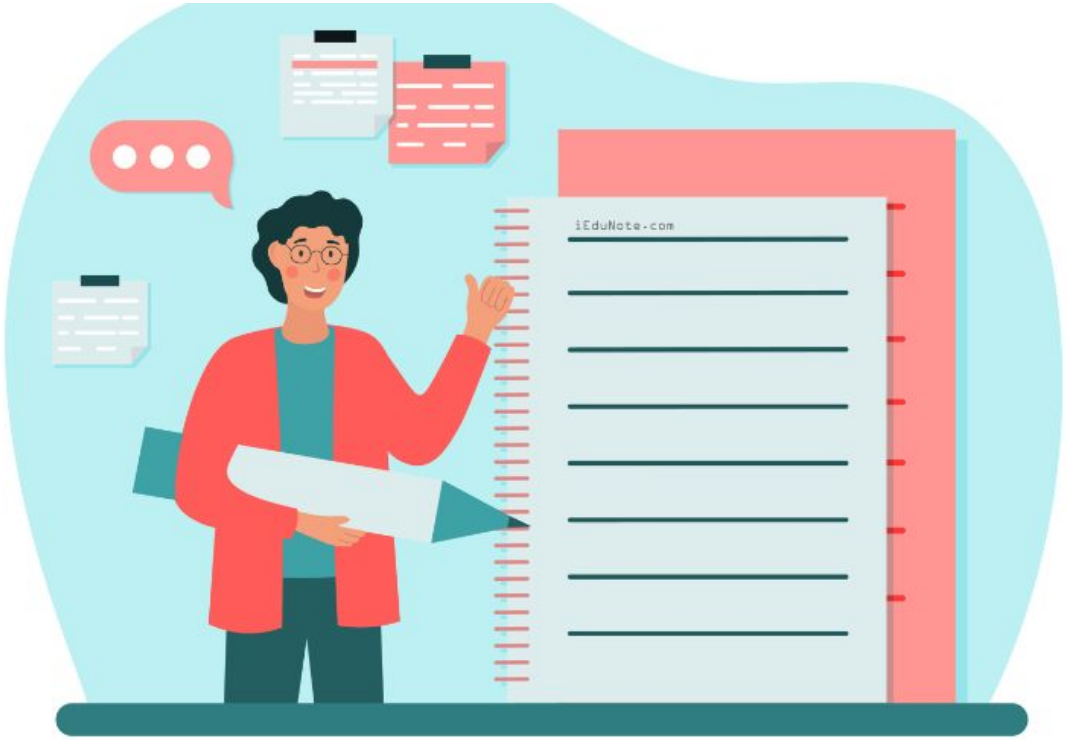
4.4 Research Process

4. PREPARING RESEARCH STUDY DESIGN

The research design is the blueprint or framework for fulfilling objectives and answering research questions.

It is a master plan specifying the methods and procedures for collecting, processing, and analyzing the collected data.

The type of research problem determines the research design and not vice-versa.



4.5 Research Process

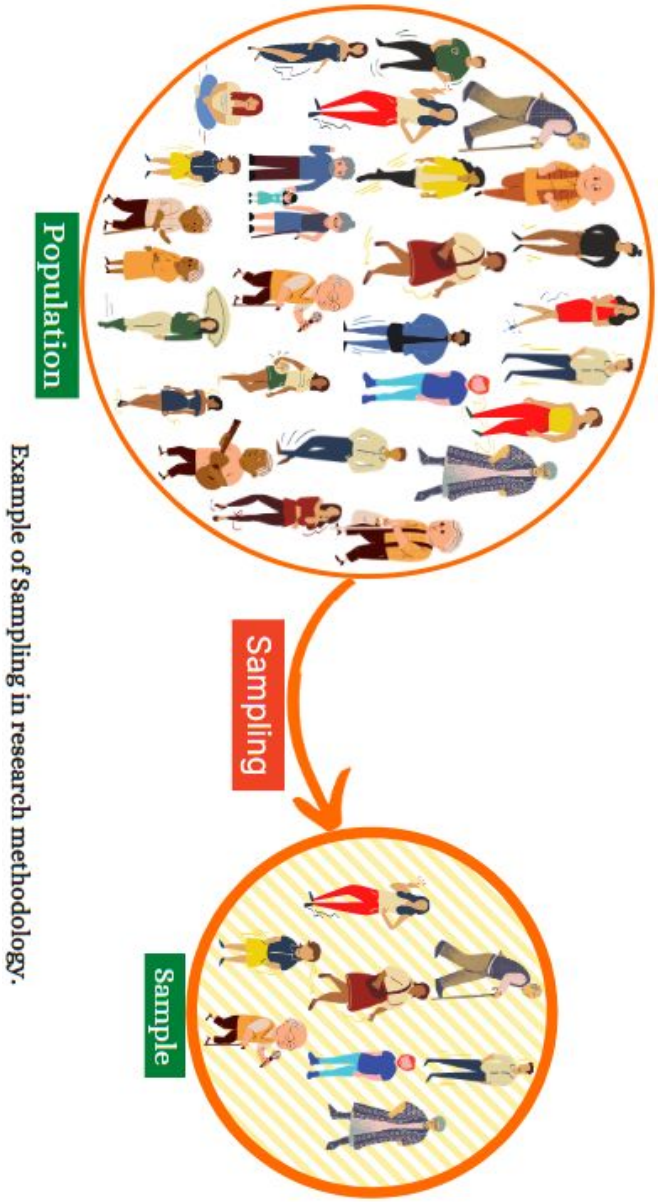
5. DECIDING THE SAMPLE DESIGN

Sampling is an important and separate step in the research process.

Sampling is the process of inferring something about a large group of elements on the basis of information collected about part of it and analyzed for understanding any aspect of the totality.
Sampling is required because study of totality is time consuming and incurs huge costs

A population is the total collection of elements we wish to make some inference or generalization.

A sample is a part of the population, carefully selected to represent that population.



Example of Sampling in research methodology.

4.5 Research Process

5. DECIDING THE SAMPLE DESIGN

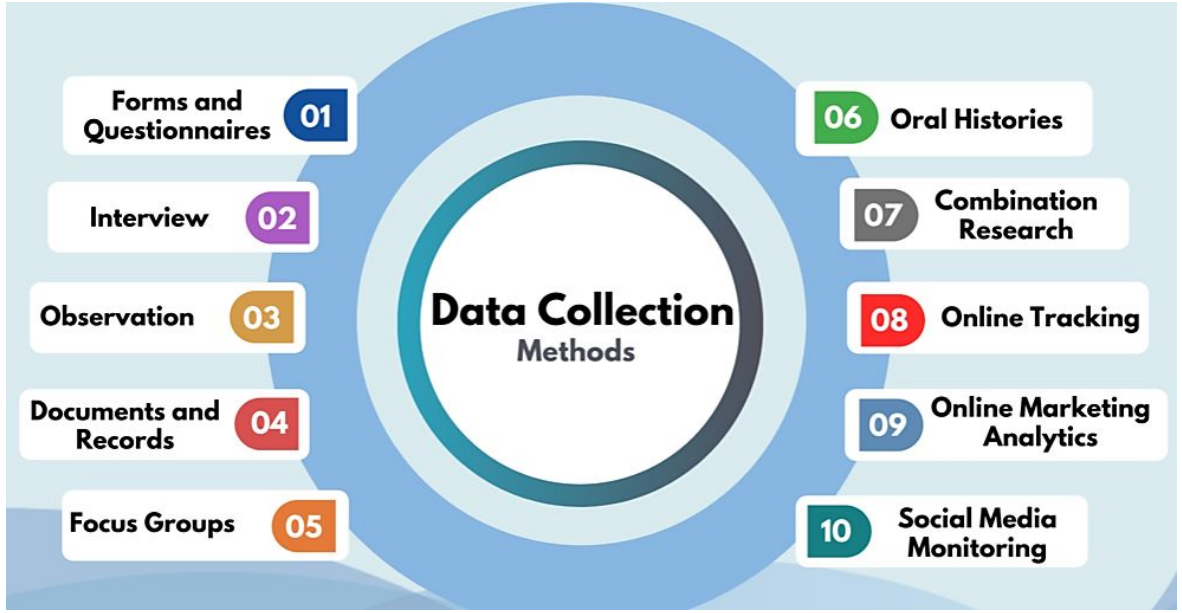
If certain statistical procedures are followed in selecting the sample, it should have the same characteristics as the population. These procedures are embedded in the sample design.

Sample design refers to the methods followed in selecting a sample from the population and the estimating technique vis-a-vis the formula for computing the sample statistics.

There are 2 methods:
Probability sampling – It ensures every unit has a known non-zero probability of selection within the target population.

Non-probability sampling – The basis of such selection is entirely dependent on the researcher's discretion. This approach is called judgment sampling, convenience sampling, accidental sampling, and purposive sampling.

4.6 Research Process



6. COLLECTING DATA

Data gathering may range from simple observation to a large-scale survey in any defined population. There are many ways to collect data.

The approach selected depends on the objectives of the study, the research design, and the availability of time, money, and personnel.

The method of data collection also varies with the variation in the type of data to be collected.

Methods like surveys, interviews, and experiments are used for collecting data.

4.7 Research Process

7. PROCESS AND ANALYZE THE DATA

Data analysis usually involves reducing accumulated data to a manageable size, developing summaries, searching for patterns, and applying statistical techniques for understanding and interpreting the findings in light of the research question

The researcher determines if his findings are consistent with the formulated hypotheses and theories.

The techniques used in analyzing data may range from simple graphical techniques to very complex multivariate analyses depending on the study's objectives, the research design employed, and the nature of the data collected.

This includes data quality assurance, statistical data analysis, modelling, and interpretation of results.

4.8 Research Process

8. HYPOTHESIS TESTING

After analyzing data, the researcher tests the hypotheses, he has formulated earlier.

There are 5 main steps in hypothesis testing:

1. State your research hypothesis as a null hypothesis (Ho – a prediction of no relationship between the variables you are interested in.) and alternate hypothesis (H1 – hypothesis that predicts a relationship between variables.).

2. Collect data in a way designed to test the hypothesis.

3. Perform an appropriate statistical test

4. Decide whether to reject or fail to reject your null hypothesis.

5. Present the findings in your results and discussion section.

4.9 Research Process

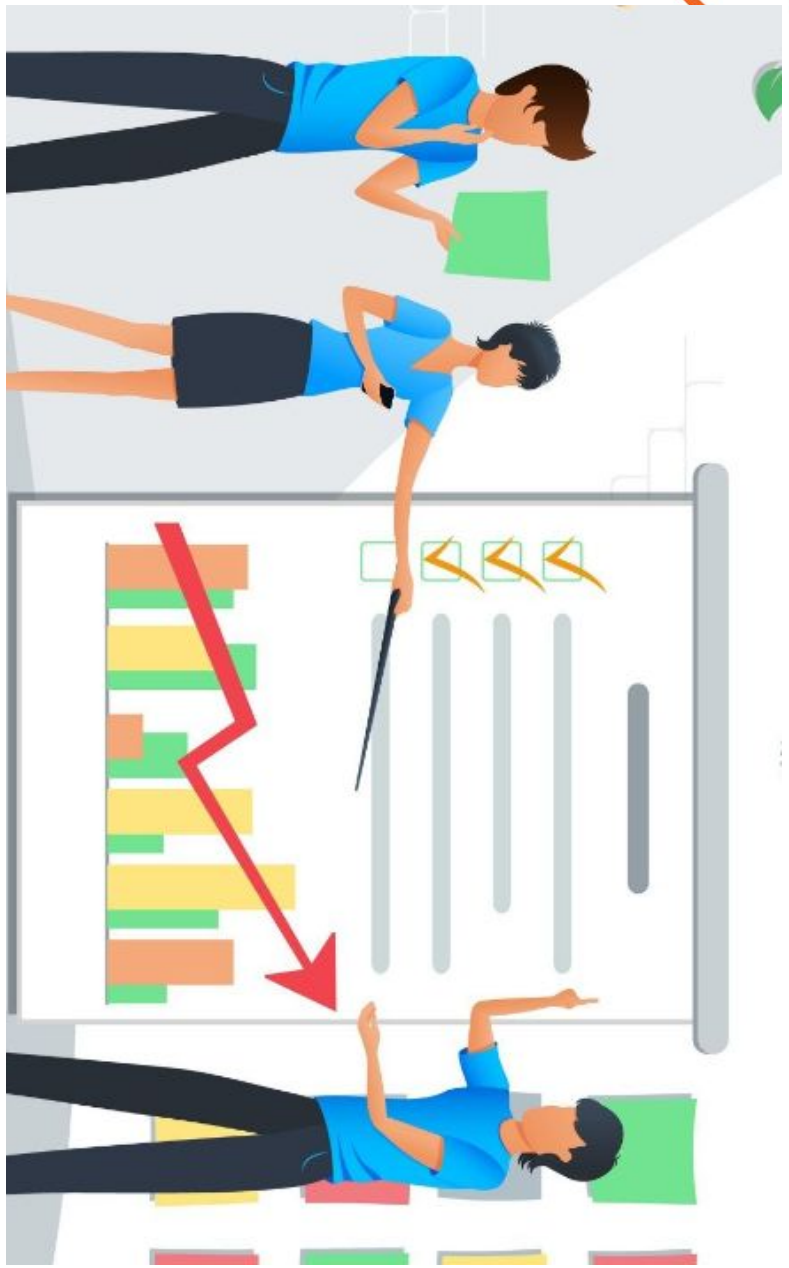
9. GENERALIZATION AND INTERPRETATION

- Once a hypothesis is tested and upheld several times, the researcher arrives at generalization, i.e., builds a theory.
- If the researcher had no hypothesis to start with, he explains his findings based on some theory. It is known as interpretation.
- The real value of research lies in its ability to arrive at certain generalizations or to provide logical interpretations.

4.10 Research Process

10. WRITING A REPORT OR THESIS

- The purpose of the research is not well served unless the findings are made known to the others.
- Research Report is a written document that presents the results of a research project or study, including the research question, methodology, results, and conclusions, in a clear and objective manner.
- Thesis is a type of research report. A thesis is a long-form research document that presents the findings and conclusions of an original research study



5 Research Ethics

- The arena of research is huge and many enthusiasts enter this field. However there may be cases where unethical means are employed to produce a report, for dodging sincere efforts and gaining quick results. For example copying someone's idea and claiming it as your own. It is wrong because of violation of 'ethics'.

- Ethics give the entire fraternity of researchers a source of discipline. Ethics lay down the ground rules for a legitimate, moral and fair research

- The role and importance of research ethics in research does not end with producing research report. Every research is like a lighthouse for future research in that field. It is moral as well as professional obligation of the researcher to conduct research according to accepted norms of ethical research.
  The various checkpoints during a research that must be taken care of by the researcher.

5 Research Ethics

Checkpoints During Research

1

Professional competence – Competence to research is not only in terms of qualification but also intellectual capability. Before beginning a research, the supervisor must ascertain that the researcher is competent to conduct research in the field chosen. Technical soundness of a research is the principal quality that is expected in a research

2

Integrity – Honesty, genuineness and fairness in research are expected from a researcher. Misrepresentation and deceit may help the research one time. But the blot of being an unethical research work never leaves the final product of the research.

3

Professional and scientific responsibility – Research work is not carried out in isolation. Societal dynamics steer the research and are affected by it. It is a moral and professional responsibility of the researcher to be aware of effects of his research. Carelessness in the research may have long lasting effects on the future research in that field, and further on the society.

5 Research Ethics

Checkpoints During Research

1

Respect for peoples' rights, dignity and diversity. Research must be free from bias and so must the researcher. The society is composed of diverse people often having conflicting rights. It is the responsibility of the researcher to incorporate the spirit of respect for all in the research and promote equality of rights in diversity of interests

2

Social responsibility. It is moral and professional obligation of researcher to conduct themselves and their research in such a way that is not disorderly to the society

3

Appropriate Techniques and Processes. The researcher must at all time conform to the laid down tools and techniques of research. Choosing the correct and appropriate methodology for the research is the primary requirement of being technically sound. Employing suitable tools and techniques of sampling, data collection and data analysis is as important as using them efficiently.

4

Research Responsibility. Every researcher is obligated to the society and to the fellow researchers, to respect and uphold integrity in research. Integrity in research is mainly upheld in two main ways:
- Sincerity in work; and -
Strictly avoid plagiarism

5 Plagiarism

Plagiarism is defined as representing a part of or the entirety of someone else's work as your own. Whether published or unpublished, this could be ideas, text verbatim, infographics, etc.

Plagiarism is not only an unethical and grossly unprofessional form of misconduct; it also amounts to a legal wrong as it is violation of an 'intellectual property right'.

It is difficult to protect an idea from being copied, as it is an intangible result of thinking; yet the final product of research can be given legal security from plagiarism. 'Research report' is a literary work and can be protected under Indian Copyright Act

6 Formulation of Research Problem

Formulation of research problem constitutes the first stage in the research process. Essentially, two issues are involved in formulation of research problem viz.,

i) understanding the problem thoroughly, and

ii) rephrasing the same into meaningful terms from an analytical point of view.

1

The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the subject.

The researcher must at the same time examine all available literature to get himself/ herself acquainted with the selected problem.

The basic outcome of this review will be the knowledge as to what research questions have been explored and what were the findings. This will enable the researcher to specify his/ her own research problem in a meaningful context

6 Formulation of Research Problem

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2

The researcher rephrases the problem into analytical or operational terms i.e., to state the problem in as specific as possible. This task of defining a research problem is a step of greatest importance in the entire research process.

The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones.

The statement of the problem determines the data which are to be collected, the characteristics of the data which are relevant, relations between variables which are to be examined, the choice of the method and techniques to be used in these investigations

6 Research Question

A **research question** pinpoints exactly what you want to find out in your work. A good research question is essential to guide your research paper, dissertation, or thesis.

All research questions should be:

- ✔ **Focused** on a single problem or issue
- ✔ **Researchable** using primary and/or secondary sources
- ✔ **Feasible** to answer within the timeframe and practical constraints
- ✔ **Specific** enough to answer thoroughly
- ✔ **Complex** enough to develop the answer over the space of a paper or thesis
- ✔ **Relevant** to your field of study and/or society more broadly