Research Methodology and IPR(23CS6AERML)

Total Credits : 3

Prescribed Text Books:

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1	Research Methodology: Methods and Techniques	Kothari C.R.	4th	New Age International	2018
2	Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar	3rd	SAGE	2011
3	Research Methodology in Computer Science	Ryhan Ebad	1st	Centrum press	2013
4	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari, Ms. Mamta Bhardwaj	1st	Publication Bureau, Punjab University	2021

Reference Text Book:

Sl. No.	Book Title	Authors	Edition	Publisher	Year
1	An introduction to Research Methodology	Bhanwar Lal Garg, Renu kavdia, Sulochana Agarwal, Umesh Kumar Agarwal	1st	RBSA	2019

Unit – 1

Research Methodology: An Introduction- Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Introduction to Research methodology in Computer Science: Computer programming, Computer Experiment, Computer Simulation, Concurrent programming, Online Ethnography, Online Focus group, Computer assisted web interviewing, Web based experiments, Methodology, Research, Applied research, online research methods

2. Introduction to Research

Meaning of Research

- 👉 Research is the systematic efforts of gathering, analysing & interpreting the problems confronted by humanity.
- 👉 It is a thinking process and scientific method of studying a problem and finding solution.

"A systematized efforts to gain new knowledge"

Characteristics of Research

- It is a systematic & critical investigation into a phenomenon.
- It adopts scientific method.
- It is objective & logical.
- It is based on empirical evidence.
- It is directed towards finding answers to question & solution to problems.
- It is not mere compilation of facts.
- It emphasis the generalization theories and principles.

Objective of research

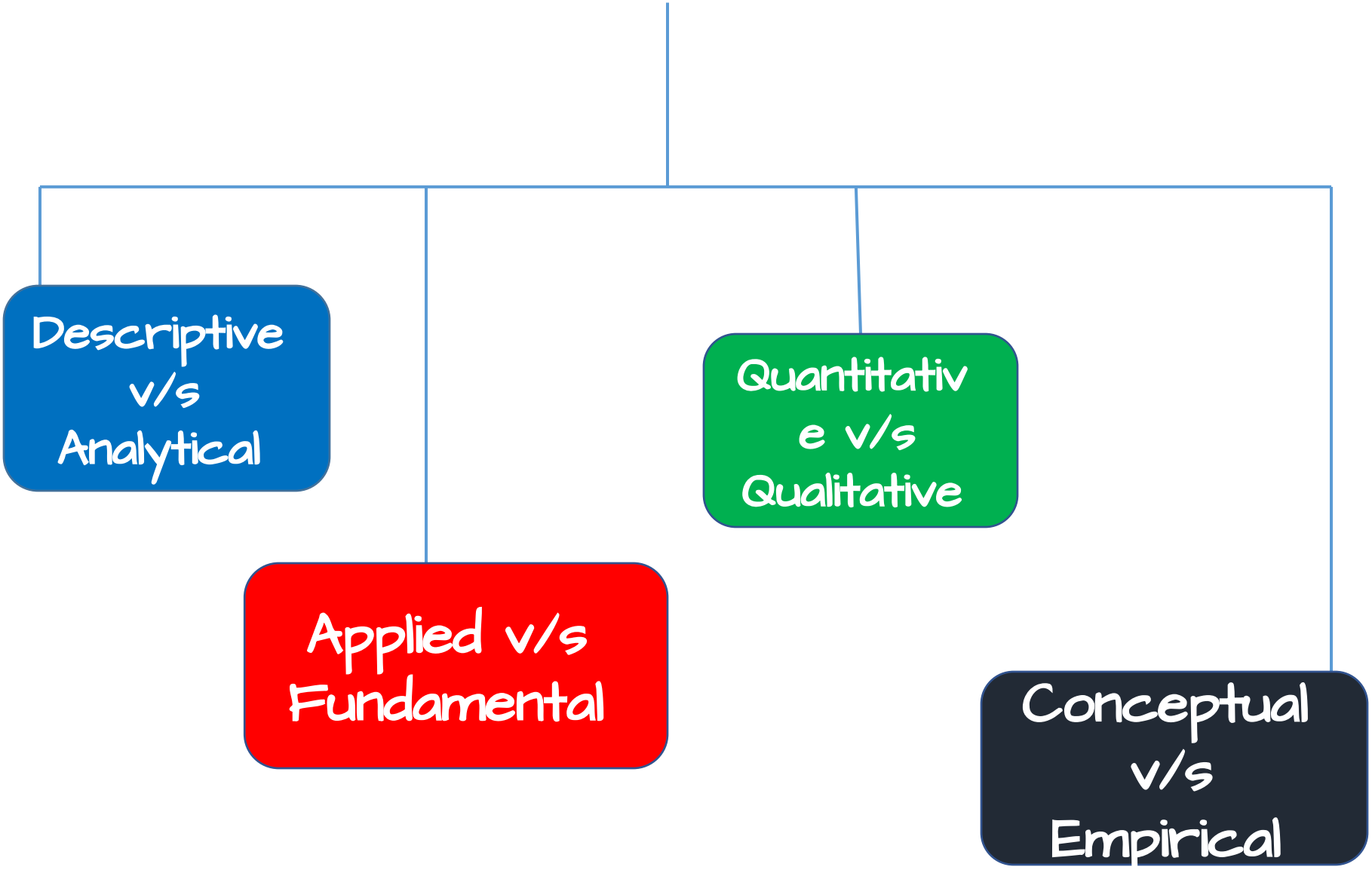
- Purpose of research is to discover answers to questions through the application of scientific procedure.
- Main aim of research is to find the truth which is hidden and which has not been discovered as yet.
- Objectives of Research can be grouped under following heads :-

1. To gain familiarity with a phenomenon or to achieve new insights into it.
2. To portray accurately the characteristics of a particular individual situation or a group.(Descriptive Research).
3. To determine the frequency with which something occurs or with which it is associated with something else.
4. To test a hypothesis of a casual relationship between variables.

Importance of research

a. It helps in finding the solution.
b. To the students who are to write a PHD; it is a careerism.
c. To Professionals in research methodology, research means a source of livehood.
d. To Philosophers & thinkers research may mean the outlet for new ideas and insights.
e. To literary man research means the development of new styles & creative work.
f. To the intellectuals research mean the generalization of new theories.

Types of Research



I. Descriptive v/s Analytical :-

- Descriptive research includes Surveys or fact-finding enquiries of different kinds.
- To describe the characteristics of a technology, system, or phenomenon. It also known as Ex-post facto research.
  - Example : A survey on the most common programming languages used in different industries.
- Analytical research the researcher has to use facts or information already available & analyse this to make a critical evaluation, of the material.
  - Example : Analyzing the impact of social media on mental health, creating a recommendation system for e-commerce websites.

I. Applied v/s Fundamental :-

- Applied Research aims at finding a solution for an immediate problem facing a society or an organisation.
  - For e.g.:- Marketing Research

- Fundamental Research is mainly concerned with Generalization and with the formulation of a theory. It is also known as pure research.
  - For e.g.:- Pure Mathematics

I. Quantitative v/s Qualitative :-

- Quantitative Research is based on the measurement of quantity or amount.
  - Examples of quantitative data:
  - Number of website visitors, Temperature in degrees Celsius, and Test score
- Qualitative Research is specially important in the behavioral sciences were the aim is to discover the underlying motives of human behaviour.
  - For e.g.:- Conducting user interviews to understand the challenges faced by software developers when using a specific programming language or tool, or studying how people interact with AI-powered virtual assistants.

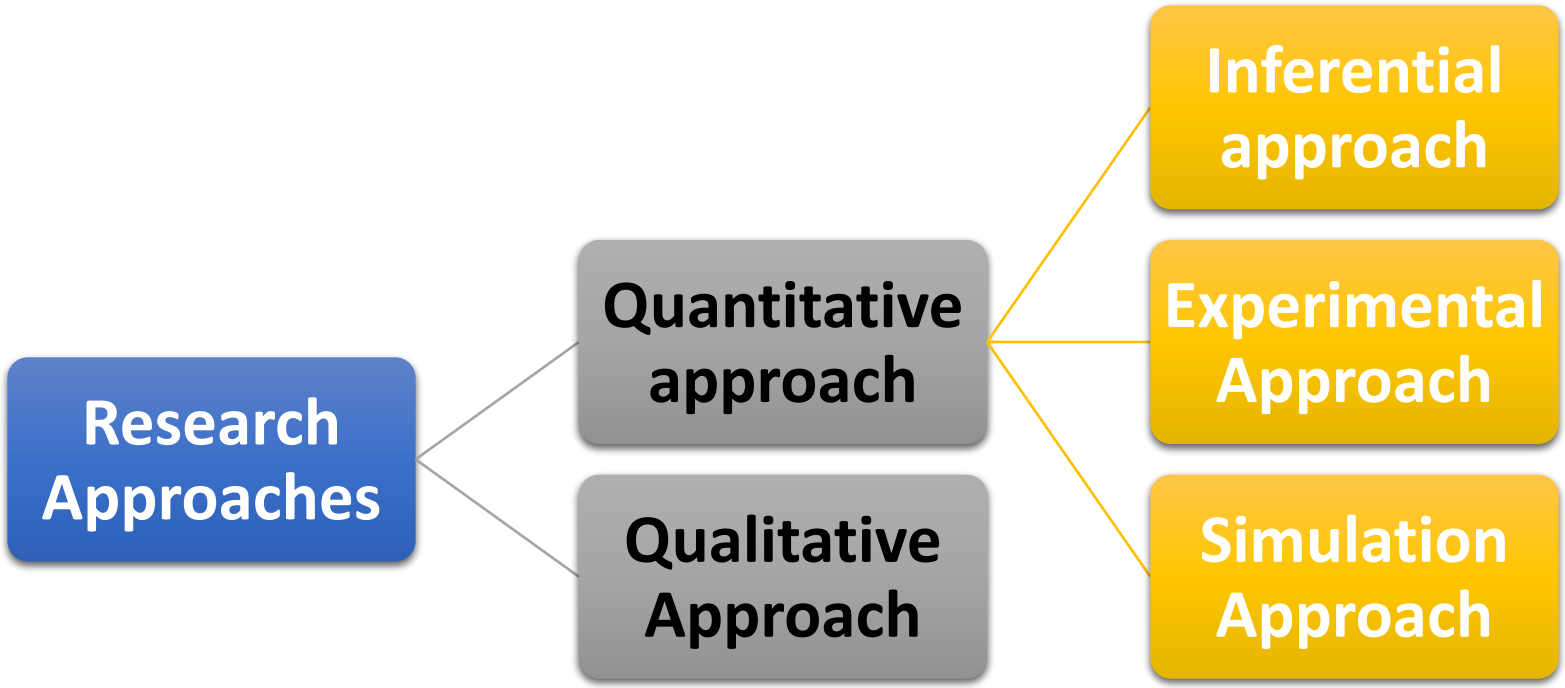
I. Conceptual v/s empirical :-

- Conceptual Research is that related to some abstract ideas for theory. It is generally used by philosophers and thinkers to develop the new concepts or to interpret existing ones.
  - Example : Developing new concepts or reinterpreting existing ones
- On the other hand, Empirical Researches relies on experiments or observation alone, often without due regard for system of theory. It is data based research coming up with conclusions which are capable of been variable of observation and experiment.
  - Testing drugs on controlled or random groups

RESEARCH APPROACHES

There are two basic approaches to research

- Quantitative approach
- Qualitative Approach



- Quantitative approach involves the generation of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion.
- This approach can be further sub-classified into
    1. Inferential approach
    2. Experimental approach
    3. Simulation approach
- The purpose of **inferential approach** to research is to form a data base from which to infer characteristics or relationships of population.
- This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.

- **Experimental approach** is characterized by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.
- Example: The Effect of Social Media Usage on Academic Performance
- **Simulation approach** involves the construction of an artificial environment within which relevant information and data can be generated.
- This permits an observation of the dynamic behavior of a system (or its sub-system) under controlled conditions.
- Simulation approach useful in building models for understanding future conditions.

- Qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behavior.
- Example the techniques of focus group interviews, projective techniques and depth interviews are used.

Significance of Research

- All progress is born of inquiry, Doubt is often better than over confidence, for it leads to inquiry and enquiry leads to invention is a famous word of

  - Hudson Maximan

- **The significance of research** lies in its ability to contribute to the advancement of knowledge, solve practical problems, and inform decision-making across various fields.
- Research is essential in every discipline, from science and technology to social sciences, medicine, education, and business.
- It provides a systematic way to explore, validate, or challenge ideas and theories, leading to innovations, solutions, and deeper understanding.

- Advancement of Knowledge
- Problem Solving
- Informed Decision Making
- Innovation and Technological Advancement
- Improving Practices and Policies
- Supporting Critical Thinking and Analytical Skills
- Enhancing Economic and Social Development
- Filling Gaps in Knowledge

- Research includes scientific and inductive thinking. It promotes the development of logical habits of thinking of organization.
- Research has increased greatly in the several fields of applied economics, whether related to business or to the economy as a whole in modern times.
- Research has its special significance in solving various operational and planning problems of business and research.
- It is helping for social scientists in studying social relationship and in seeking answers to various social problems.
- For students of masters or Ph.D – helping to write thesis and research may mean a careerism or a way to attain a high position in the social structure.
- To professional in research methodology - research may mean a source of livelihood.
- To Philosophers and Thinkers – research may mean the outlet for new ideas and insights.
- To literary men and women - research may mean the development of new styles and creative work.
- To analyst and Intellectuals – research may mean the generalizations of new theories.

Difference Between Research Methods & Research Methodology

S.No.	Basis	Research Methods	Research Methodology
1.	Meaning	It implies the methods employed by researcher to conduct research.	It is the way to systematically solve the research problems.
2.	What is it ?	Behavior and instrument used in the selection and construction of the research technique.	Science of understanding, how research is performed methodically.
3.	Encompasses	Carrying out experiment, test, surveys and so on.	Study different techniques which can be utilized in the performance of experiment, test, surveys etc.
4.	Comprise of	Different investigation techniques.	Entire strategy towards achievement of objective.
5.	Objective	To discover solution to research problem.	To apply correct procedures so as to determine solutions.

Exploring the Impact of Online Learning on High School Students' Academic Performance

- **Research Question:** How does online learning affect the academic performance of high school students?

Research Method:

- The **research method** refers to the specific techniques or tools the researcher will use to gather and analyze data.
- **Method Used:**
- **Survey Method**: The researcher decides to use a **survey** to collect data from high school students. A questionnaire is designed with a series of questions related to their online learning experiences, study habits, and academic performance. The survey is distributed to 200 students in different high schools.
- **Data Collection**: The researcher collects responses from the students, focusing on questions like:
  - "How many hours do you spend on online learning each week?"
  - "Do you feel online learning has helped you improve your grades?"
  - "How satisfied are you with the online learning experience?"
- **Data Analysis**: The responses are analyzed quantitatively to look for trends, patterns, or correlations between online learning hours and students' academic performance (measured by grades).

Research Methodology:

- The **methodology** refers to the theoretical framework or philosophical approach behind choosing the research method and how the research is conducted.
- It addresses **why** a particular method is selected and the reasoning behind it.
- **Methodology Chosen:**
- **Quantitative Methodology**: The researcher chooses a **quantitative methodology** because they want to measure the relationship between the amount of online learning and academic performance in numerical terms (e.g., hours of online learning vs. grades).
    - The researcher assumes that there is a measurable, objective relationship between online learning and academic performance.
- **Approach**: In this case, the research is focused on gathering numerical data from surveys and then applying statistical analysis to test hypotheses (such as whether more hours of online learning lead to better academic performance).

Research and Scientific Method

- ‘Science’ refers to the body of systematic and organised knowledge which makes use of scientific method to acquire knowledge in a particular field of enquiry.

- Scientific method is the systematic collection of data (facts) and their theoretical treatment through proper observation, experimentation and interpretation.

- Scientific method attempts to achieve a systematic interrelation of facts by experimentation, observation, and logical arguments from accepted postulates and a combination of these three in varying proportions.

Research and Scientific Method

- **Research**: An inquiry into the nature of reasons for and consequences of circumstances.
- **Scientific Method**: A systematic approach to gathering, testing, and analyzing information.
- **Relationship**: The scientific method is the philosophy common to all research methods.

Research involves:

- Inquiry into circumstances, both controlled and natural.
- Interest in repeatability and extension of results to broader situations.
- Not just seeking specific results, but generalizability of findings.

Defining the Scientific Method

- Achieve systematic interrelation of facts through experimentation, observation, and logical arguments.

- **Core Aspects of Scientific Method**
  1. Logical Considerations: Helps in formulating propositions and evaluating alternatives.
  2. Empirical Evidence: Conclusions drawn from data and observation.
  3. Objective and Ethical Neutrality: Focus on making correct, unbiased statements.
  4. Probabilistic Predictions: Focus on predictions with a degree of certainty.
  5. Replicability: Methodology must be open for testing and validation by others.
- **Experimentation in Scientific Method**

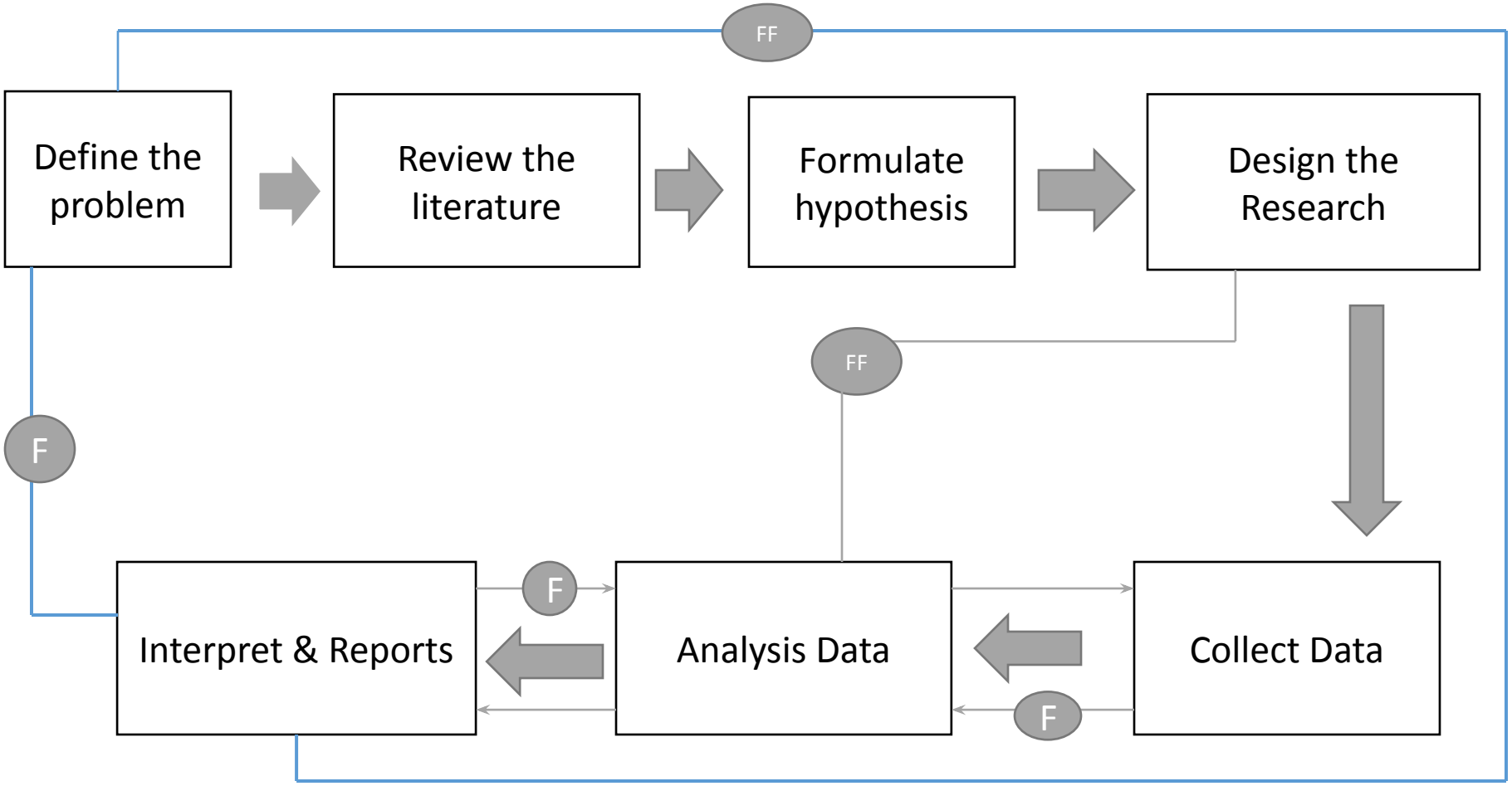
  To test hypotheses and uncover new relationships among variables.
- **Survey Investigations in Scientific Method**

  To gather scientifically valid data for drawing conclusions.

BASIC POSTULATES IN SCIENTIFIC METHOD

- It relies on empirical evidence.
- It utilizes relevant concepts.
- It is committed to only objective considerations.
- It results into probabilistic predictions.
- The methodology is made known.
- Aims at formulating scientific theories.

Research Process



Where, F = feed back (Helps in controlling the sub-system to which it is transmitted)
FF = feed forward (Serves the vital function of providing criteria for evaluation)

I. Define the problem :-

- The first step of research process is to define the problem.
- There are two types of research problem:-

i. Those which relates to **state of nature.**

ii. Those which relates to **relationship between variables**.

- Essentially two steps are involved in define research problems :-

a. Understanding the problem thoroughly.

b. Rephrasing the same into meaningful terms from an point of view.

II. Review the literature :-

- Once the problem is define, a brief summary, should be written down.
- It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of topic and submit it to necessary committee or the research board for approval.

iii. Formulate hypothesis : -

- The next step is to formulate hypothesis. It is tentative assumption made in order to draw out and test its logical or empirical consequences. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested.
- The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track.

Example 1: The Effect of Study Time on Academic Performance

1. **Identify the Variables:**
    1. **Independent Variable (IV)**: **Study time** (the amount of time spent studying).
    2. **Dependent Variable (DV)**: **Academic performance** (measured by grades, exam scores, etc.).
2. **Establish a Relationship:**
    1. **Type of Relationship**: Positive relationship (the more time a student spends studying, the higher their academic performance is expected to be).
    2. **Cause-and-Effect Relationship**: Study time is believed to cause an improvement in academic performance.
3. **Make the Hypothesis Testable:**
    1. **Hypothesis**: "The more time students spend studying, the higher their academic performance will be on their final exams."

iv. Design the Research :-

- The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted.
- The function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money.
- Research purpose may be grouped into four categories, i.e. (a). Exploration; (b). Description; (c). Diagnosis; (d). Experimentation.

V. Collect The Data :-

- The next step is to collect the data.
- There are several ways to collect the data are :-

1. By Observation
2. Through personal interview
3. Through telephone interview
4. By mailing of questionnaires
5. Through schedules

- The researcher should select one of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy.

Vi. Analysis the Data :-

- After the data have been collected, the researcher turns to the task of analysing them.
- The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences.

Vii. Interpret & Report

- Research has to prepare the report of what has been done by him.
- Writing of report includes :-

1. The preliminary pages
2. The main text
3. The end matter

Criteria of Good Research.

- Purpose clearly defined.
- Research process detailed.
- Research design thoroughly planned.
- High ethical standards applied.
- Limitations frankly revealed.
- Adequate analysis for decision maker’s needs.
- Findings presented unambiguously.
- Conclusions justified.
- Researcher’s experience reflected