

FYUGP
RESEARCH METHODOLOGY (SCIENCE)
SEMESTER VII
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Unit I: Introduction to Research (10 Lectures + 5 Tutorials):18 Marks

Meaning, objectives and significance of research;

Types of research (basic, applied, experimental, descriptive, exploratory, survey, qualitative);

Research approaches and methods vs. methodology;

Stages of the research process and criteria of good research;

Identification and formulation of a research problem;

Formulating research questions, hypotheses, aims and objectives.

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1.1 Meaning, Objectives and Significance of Research

Introduction

Human beings are naturally curious. From the earliest civilizations, people have asked questions about the world around them and searched for reliable answers. **Research** is the modern, systematic form of this age-old curiosity. It is the backbone of every academic discipline and the engine that drives progress in science, technology, medicine, business, and the social sciences. Before studying how to conduct research (methodology), it is essential to understand what research means, what it aims to achieve, and why it matters.

Meaning of Research

The word **research** is derived from the French word *recherche*, meaning “to search again” or “to examine carefully.” Literally, therefore, research means a careful, repeated and thorough search for knowledge. In academic terms, research is a **systematic and scientific process of enquiry** undertaken to discover new facts, verify existing knowledge, and solve problems through the collection, analysis and interpretation of data.

Key Definitions

Clifford Woody: Research comprises “defining and redefining problems, formulating hypotheses or suggested solutions; collecting, organising and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.”

C. R. Kothari: Research is “a scientific and systematic search for pertinent information on a specific topic.”

John W. Best: Research is “the systematic and objective analysis and recording of controlled observations that may lead to the development of generalisations, principles or theories.”

Redman & Mory: Research is a “systematised effort to gain new knowledge.”

Characteristics of Research:

From these definitions, the essential features of research can be summarised as follows:

- **Systematic:** It follows a definite, logical sequence of steps rather than a random or haphazard approach.
- **Objective and logical:** It relies on evidence and reasoning, and seeks to remove personal bias and prejudice.
- **Empirical:** Conclusions are based on observable, measurable data collected from reality, not merely on opinion.
- **Directed towards a problem:** Every research begins with a clearly defined question or problem to be solved.
- **Controlled:** The influence of different factors is identified and, as far as possible, kept under control, especially in experimental studies.
- **Verifiable and replicable:** Findings can be checked and repeated by other researchers under similar conditions.
- **Cyclical and cumulative:** It often raises new questions, and each study builds upon the knowledge created by earlier work.

Objectives of Research:

The broad purpose of all research is **to discover the truth which is hidden and which has not yet been discovered**. Although each individual study has its own specific aim, research in general is undertaken to achieve one or more of the following objectives:

A. Broad (General) Objectives

1. **Exploratory / Formulative:** To gain familiarity with a phenomenon or to achieve new insights into it — often to explore a relatively unknown area and to formulate a problem more precisely.
2. **Descriptive:** To portray the characteristics of a particular individual, situation, group or event, answering questions such as who, what, when, where and how.
3. **Diagnostic:** To determine the frequency with which something occurs or the way in which it is associated with something else — identifying causes and relationships.
4. **Hypothesis-testing (Explanatory):** To test a hypothesis about a causal relationship between variables, explaining why and how something happens.

B. Specific Aims Research Seeks to fulfil

- To discover new facts and add to the existing stock of knowledge.
- To verify and test important facts, theories and existing conclusions.
- To analyse events, processes and relationships in order to understand cause and effect.
- To develop new scientific tools, concepts and theories for solving problems.
- To find practical solutions to social, economic, industrial and technical problems.
- To make predictions about future events on the basis of established relationships.

Significance of Research:

Research plays a vital role in almost every sphere of modern life. As the economist *Robert Merton* and others have observed, the increasing complexity of society makes reliable knowledge more important than ever. The significance of research can be appreciated from the following points of view:

I. Advancement of Knowledge

Research is the primary source of new knowledge. It continually adds to what is already known, corrects earlier errors, and forms the foundation on which all academic disciplines grow. Without research, knowledge would remain static.

II. Solving Problems

Research provides a rational, evidence-based method for solving operational and planning problems in business, government, industry and daily life. It replaces guesswork and intuition with systematic analysis.

III. Policy Formulation and Planning

Governments rely heavily on research to frame sound policies and to allocate resources wisely. Economic and social surveys, census data and market studies guide decisions on taxation, welfare, health, education and development planning.

IV. Basis for Decision-Making in Business

In the world of trade and commerce, research into markets, consumer behaviour and operations helps firms to identify opportunities, minimise risks, and make profitable, informed decisions.

V. Development of Society and Human Welfare

Advances in medicine, agriculture, engineering and technology — vaccines, high-yield crops, communication systems — are direct results of sustained research, improving the quality and standard of human life.

VI. Intellectual and Career Value

For students and scholars, research sharpens critical thinking, cultivates objectivity and discipline, and develops the ability to analyse and interpret information. As *C. R. Kothari* notes, research may mean a **career** or a way of life for professionals, and a means of intellectual satisfaction and livelihood for many.

Significance of research in a nutshell:

1. Adds to knowledge and promotes learning.
2. Provides a scientific basis for solving problems.
3. Guides government policy and national planning.
4. Supports sound decision-making in business and industry.

1.2 Types of Research

Introduction:

Research is a **systematic, objective and organised enquiry** undertaken to discover new facts, verify existing knowledge, or solve a problem. Because research serves many purposes and uses many methods, it is classified into several **types**. These types are not mutually exclusive — a single study may, for example, be both applied and experimental, or descriptive and survey-based. Classifying research helps a student choose the right approach, design suitable tools, and understand where a given study fits within the larger body of knowledge.

Research is commonly classified on three broad bases: by **application** (basic vs. applied), by **objective** (descriptive, exploratory, explanatory/experimental), and by the **nature of data and enquiry** (quantitative vs. qualitative; survey being a common method of collecting such data). Three different bases of research are:

- **Based on application/purpose:** Basic (pure/ Fundamental) and Applied research.

- **Based on objective:** Descriptive, Exploratory and Explanatory (experimental) research.
- **Based on inquiry mode/data:** Quantitative and Qualitative research; Survey is a widely used mode of data collection.

1. Basic (Pure / Fundamental) Research

Research carried out mainly to add to the existing body of scientific knowledge, to develop or test theories, and to arrive at generalisations — without any immediate concern for its practical use.

Key features:

- Driven by **curiosity** and the desire to know; theory-oriented.
- Findings are **general**, not tied to one particular situation.
- Often long-term; forms the **foundation** on which applied research is later built.

Example: *Newton's study of the laws of motion, or research on how human memory encodes information.*

2. Applied Research

Research aimed at finding a solution to an immediate, specific and practical problem faced by an individual, organisation or society.

Key features:

- Problem-oriented and **action-oriented**; results are put to use quickly.
- Findings apply to a **particular situation** rather than being broadly generalised.
- Frequently uses the theories produced by basic research.

Example: *Research to find why sales of a product are falling in a region and how to improve them, or developing a vaccine for a specific disease.*

3. Conceptual Research:

Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

4. Experimental Research/ Empirical Research

Research in which the investigator deliberately manipulates one or more variables (the independent variables) under controlled conditions to observe the effect on another variable (the dependent variable), to establish cause-and-effect relationships. Evidence gathered through experiments or empirical studies are the most powerful support possible for testing a given hypothesis.

Key features:

- Involves an **independent variable** (cause), a **dependent variable** (effect) and **control** of other factors.
- Usually uses an **experimental group and a control group**, with random assignment where possible.
- Conducted in a laboratory or field setting; highly **objective and replicable**.

Example: *Giving a new teaching method to one group of students (experimental group) and the usual method to another (control group) to test which produces better marks.*

5. Descriptive Research (Ex post facto research)

Research that systematically describes the characteristics, behaviour or conditions of a person, group, situation or phenomenon as they exist at present. It answers 'what is' rather than 'why'.

Key features:

- Concerned with **describing**, not manipulating; variables are studied as they are.
- Includes surveys, case studies, comparative and correlational studies.
- The researcher has **no control** over the variables — only reports what exists.

Example: *A study describing the socio-economic background, study habits and attendance patterns of first-year students in a college.*

6. Exploratory Research

Research conducted into a problem that is not clearly defined or has been little studied, in order to gain preliminary insight, become familiar with the issue and formulate problems or hypotheses for later, more detailed research.

Key features:

- Carried out in the **early stage** of enquiry; flexible and open-ended in design.
- Aims to **formulate hypotheses** rather than test them.
- Uses literature review, expert interviews and small pilot studies.

Example: *A preliminary study to understand the reasons behind a newly noticed rise in student use of a particular social-media app.*

7. Survey Research

A method of research in which information is collected from a sample of respondents drawn from a population, usually through questionnaires or interviews, in order to describe, compare or explain the characteristics of that population.

Key features:

- Studies a **sample** and generalises the findings to the whole population.
- Main tools are the **questionnaire, schedule and interview**.
- Can be descriptive (describing opinions/facts) or analytical (examining relationships); economical for large groups.

Example: *A pre-election opinion poll, or a household survey on consumer spending habits.*

8. Qualitative Research

Research concerned with understanding the meanings, experiences, opinions and reasons that lie behind human behaviour, using non-numerical (verbal, descriptive) data rather than statistics.

Key features:

- Data are **words, descriptions and observations**, not numbers.
- Answers '**why**' and '**how**'; explores depth of meaning and context.
- Methods include in-depth interviews, focus groups, case studies, observation and content analysis. (Its counterpart, *quantitative research*, uses numerical data and statistics.)

Example: *In-depth interviews with college dropouts to understand the personal and social reasons for leaving their studies.*

Comparative Overview:

The table below summarises the seven types of research by their purpose and a typical example.

Type	Basis / Purpose	Example
Basic (Pure / Fundamental)	To add to existing knowledge; develop theories and generalisations	Studying how memory is stored in the brain
Applied	To solve a specific, practical, immediate problem	Finding ways to reduce a company's employee turnover
Experimental	To establish cause-and-effect by manipulating variables under controlled conditions	Testing whether a new fertiliser increases crop yield
Descriptive	To describe characteristics of a group or situation as they exist	A survey of literacy rates across districts

Type	Basis / Purpose	Example
Exploratory	To gain initial insight into a little-understood problem; to formulate hypotheses	A pilot study on a newly emerging social-media trend
Survey	To collect data from a sample using questionnaires/interviews to describe a population	A voter-opinion poll before an election
Qualitative	To understand meanings, experiences and reasons behind behaviour (non-numerical)	In-depth interviews on why students drop out of college

Distinguish between basic and applied research:

Basic Research	Applied Research
Basic research expands the existing scientific knowledge base.	Applied research refers to scientific study that helps solve real-life problems.
Basic research is purely theoretical	Applied research has a practical approach
Basic research is universally applicable.	Can be applied only to the specific problem for which it was carried out.
The primary concern of basic research is to develop scientific knowledge and predictions.	Applied research stresses developing technology and techniques with the help of basic science.
The fundamental goal of basic research is to add to existing knowledge.	Applied research is directed towards finding a solution to the problem under consideration.

1.3 Research Approaches and Methods vs. Methodology

Introduction

Research is a systematic and organised effort to investigate a specific problem, answer a question, or add to existing knowledge. When students begin research, three terms are used so often that they are frequently confused: **research approach**, **research methods**, and **research methodology**. Although related, each occupies a different level in a research project. Understanding how they differ and how they fit together is the foundation of designing sound research. A simple way to picture the relationship:

Approach (the plan and reasoning) → **Methodology** (the strategy and justification) → **Methods** (the specific tools and techniques).

The approach and methodology set the direction and logic; the methods carry out the work.

Research Approaches: A **research approach** is the broad plan and orientation that guides how a study moves from underlying assumptions to detailed methods of data collection, analysis, and interpretation. It reflects the researcher's philosophical stance and the nature of the problem being studied. The three most widely recognised approaches are:

a) Quantitative approach:

Based on the measurement of quantity or amount. It deals with numerical data, statistics, and measurable variables, and is used to test hypotheses, establish relationships, and generalise findings to larger populations. It follows a largely *deductive* logic (*theory* → *hypothesis* → *observation* → *confirmation*). Example: a survey measuring the effect of study hours on examination scores.

b) Qualitative approach:

Concerned with the qualitative phenomena — meanings, experiences, opinions, and behaviour that cannot easily be reduced to numbers. It seeks depth of understanding rather than statistical generalisation and often follows an *inductive* logic (*observation* → *pattern* → *theory*). Example: interviews exploring why students feel anxious before examinations.

c) Mixed-methods approach:

Combines quantitative and qualitative approaches within a single study to draw on the strengths of both using numbers to measure and words to explain. Example: a survey (quantitative) followed by focus-group discussions (qualitative) to interpret the results.

Approaches are also described by their reasoning: **deductive** (testing an existing theory) and **inductive** (building theory from data).

Research Methods

Research methods are the specific techniques, tools, and procedures used to carry out research — that is, to collect and analyse data. They are the practical "how-to" of research: the actual activities a researcher performs. Research methods can be grouped by function:

a) Methods of data collection, such as questionnaires, interviews, observation, experiments, case studies, and use of secondary sources (documents, records, archives).

b) Statistical and analytical techniques, used to establish relationships between the data and the unknowns for example, correlation, regression, chi-square tests, or thematic analysis for qualitative data.

c) Methods to evaluate the accuracy of results, including tests of validity, reliability, and significance.

The scientific method is thus based on certain basic postulates which can be stated as under (Kothari and Garg, 2019):

- i. It relies on empirical evidence;
- ii. It utilizes relevant concepts;
- iii. It is committed to only objective considerations;
- iv. It aims at nothing but making only adequate and correct statements about population objects;
- v. It results into probabilistic predictions;
- vi. Its methodology is made known to all concerned for critical scrutiny and are for use in testing the conclusions through replication;
- vii. It aims at formulating most general axioms or what can be termed as scientific theories.

Research Methodology

Research methodology is the science of *how research is done systematically*. It is a broader concept than methods: it is the study, description, and justification of the methods applied to a research problem, along with the logic behind their selection.

Methodology answers questions such as:

- Why has a particular research problem been defined in this way?
- Why has this approach (quantitative/qualitative/mixed) been adopted?
- Why has a particular method of data collection been chosen over others?
- Why is this technique of analysis suitable, and what are its limitations?

In short, methodology is concerned not only with *what* methods are used but with the **reasoning, assumptions, and rationale** that make those methods appropriate for the problem. It considers the philosophy underlying the research, the logic of the design, and the criteria by which the study can be judged trustworthy.

Thus, **methods are a part of methodology**. A researcher who knows methods know *how* to do something; a researcher who understands methodology knows *how* and *why*, and can evaluate whether the results are meaningful.

Methods vs. Methodology — The Core Distinction:

Basis	Research Methods	Research Methodology
Meaning	The techniques and procedures used to conduct research	The systematic study and justification of the methods used
Scope	Narrow — a part of methodology	Broad — includes methods plus the reasoning behind them
Focus	<i>What</i> is done and <i>how</i> (tools, procedures)	<i>Why</i> it is done that way (logic, rationale, assumptions)
Stage of use	Applied during the later, operational stage of research	Guides the study from the planning stage onwards
Question answered	"How is the data collected and analysed?"	"Why are these methods appropriate for this problem?"
Nature	Practical / operational	Analytical / evaluative
Example	Conducting a questionnaire survey and running a t-test	Justifying why a survey and a t-test suit this research question

All methods are used within a methodology, but methodology is much more than the methods, it is the study of the entire research process and the reasoning that supports it.

How They Fit Together:

Consider a student researching *"the impact of social media on the academic performance of undergraduates."*

- **Approach:** A quantitative approach is chosen because performance and usage can be measured numerically.
- **Methodology:** The researcher justifies this choice — explaining why a survey design suits a large sample, why random sampling is used, and why correlation analysis is appropriate, while acknowledging limitations such as self-reported data.
- **Methods:** A structured questionnaire is administered, data are collected from 200 students, and Pearson's correlation is computed.

Here, the *approach* sets the direction, the *methodology* provides the justified strategy, and the *methods* are the actual tools used.

SUMMARY

Research approaches describe the overall orientation of a study (quantitative, qualitative, or mixed) and its reasoning (deductive or inductive). Research methods are the concrete tools and techniques for collecting and analysing data. Research methodology is the wider, reflective study of those methods the systematic logic and justification that explains why the chosen methods are suitable for the research problem. Methods tell us *how*; methodology tells us *how and why*. For an undergraduate, mastering this distinction is essential because a good project is judged not only on the techniques used but on the soundness of the reasoning behind them.

1.4 Stages of the Research Process and Criteria of Good Research

Introduction

Research is a systematic activity: it does not proceed randomly but moves through a series of connected, logically ordered steps. Understanding these steps helps a researcher plan work carefully, avoid errors, and produce results that others can trust. Equally important is knowing what makes research *good* — the standards or criteria by which any piece of research is judged. This note explains the **stages of the research process** and then sets out the **criteria of good research**.

Although the stages are presented in sequence, in practice they overlap and the researcher often moves back and forth between them. This looping-back is called the **iterative** nature of research.

Stages of the Research Process

Stage 1 — Identifying and defining the research problem. The starting point of all research. The researcher selects a broad subject area, narrows it to a specific problem, and states it clearly. A well-defined problem is specific, feasible, and researchable. Example: narrowing "student learning" to "the effect of online classes on the concentration of first-year students."

Stage 2 Review of literature. The researcher studies existing books, journal articles, reports, and earlier studies related to the problem. This helps to understand what is already known, avoid duplication, refine the problem, and identify gaps that the new study can fill.

Stage 3 Formulating hypotheses or research questions. A **hypothesis** is a tentative, testable statement about the expected relationship between variables (e.g., "online classes reduce students' concentration"). In exploratory or qualitative work, broad **research questions** are framed instead of formal hypotheses. This stage gives the research a clear focus and direction.

Stage 4 Preparing the research design. The research design is the overall blueprint or plan for conducting the study. It specifies the type of research (descriptive, exploratory, experimental, etc.), the sources of data, the sampling plan, and the methods of data collection and analysis. A good design maximises reliable information while minimising time, cost, and effort.

Stage 5 Determining the sample and collecting data. The researcher decides the **population** and selects a **sample** (using probability or non-probability sampling). Data are then gathered using

appropriate methods such as questionnaires, interviews, observation, experiments, or secondary sources.

Stage 6 Processing and analysing data. Collected data are edited, coded, classified, and tabulated. They are then analysed using suitable statistical techniques (percentages, averages, correlation, tests of significance) or, for qualitative data, techniques such as thematic analysis. Analysis, where relevant, includes testing the hypotheses.

Stage 7 Interpretation and generalisation. The researcher explains what the results mean, relates them back to the hypotheses and the reviewed literature, and draws conclusions. Where justified, findings may be generalised to the wider population, and their significance is discussed.

Stage 8 Preparing the research report. The final stage is writing up the study. The report usually contains a preliminary section (title, acknowledgements, contents), a main body (introduction, review of literature, methodology, findings, discussion, conclusion), and an end section (references, appendices). Clear reporting allows others to understand, evaluate, and build on the work.

Flow of the process:

Problem → Literature Review → Hypothesis → Research Design → Sampling & Data Collection → Data Analysis → Interpretation → Report Writing.

Feedback loops connect the stages, findings at a later stage may send the researcher back to refine an earlier one.

Criteria of Good Research

Whatever the field, good research shares certain qualities. The main criteria are:

a) Clearly defined purpose. The aim, problem, and objectives of the study are stated in specific terms so that everyone understands what is being investigated.

b) Systematic and well-planned procedure. The research follows a logical, orderly method. The design and procedures are described in enough detail for another researcher to repeat the study.

c) Careful and adequate design. The methods are appropriate to the problem, and the design is planned to yield results that are as objective as possible.

d) Objectivity and freedom from bias. Findings are based on evidence, not on the researcher's personal opinions or prejudices. Data are reported honestly, including results that do not support the hypothesis.

e) Reliability. The study is consistent — if repeated under the same conditions, it would produce the same or very similar results.

f) Validity. The research measures what it claims to measure, and the conclusions genuinely follow from the data.

g) Adequate analysis and justified conclusions. The data are analysed with methods suitable to the study, and conclusions are limited to what the evidence supports — no over-generalisation.

h) Ethical soundness. The research respects the rights of participants — informed consent, confidentiality, honesty, and avoidance of harm — and reports data truthfully without plagiarism or fabrication.

i) Replicability and verifiability. Because the procedure is fully reported, others can verify or reproduce the results, which strengthens confidence in the findings.

j) Contribution to knowledge. Good research adds something — it answers a question, tests a theory, solves a problem, or opens the way for further study.

A useful summary: **good research is systematic, logical, empirical, replicable, objective, and ethical.**

Summary

The research process is a logically ordered sequence of stages — defining the problem, reviewing the literature, forming hypotheses, designing the study, sampling and collecting data, analysing it, interpreting the findings, and reporting them — with feedback loops linking the stages. Research is judged good when it has a clear purpose, a systematic and carefully designed procedure, objectivity, reliability, validity, sound analysis, ethical conduct, replicability, and a genuine contribution to knowledge. Following the stages carefully and meeting these criteria is what separates dependable research from mere information-gathering.

1.5 Identification and Formulation of a Research Problem

Introduction

Every research study begins with a **research problem** — the specific question, difficulty, or gap in knowledge that the researcher sets out to investigate. Choosing and stating this problem correctly is the single most important step in research, because everything that follows (design, data collection, analysis) depends on it. A vague or poorly stated problem leads to confused, unfocused research; a clear one gives the whole study direction and purpose.

This process has two connected parts:

Identification is the finding and selecting a suitable problem to study.

Formulation means refining that broad problem into a precise, researchable statement.

What is meant by Research Problem?

A research problem is a clearly stated issue, difficulty, or unanswered question that a researcher wishes to study and resolve. It usually exists where there is a **gap** between what is known and what needs to be known, or where a difficulty is faced in theory or practice.

According to **Kerlinger**, a research problem is an interrogative statement that asks what relationship exists between two or more variables. The components of a research problem generally include: a person or group facing the difficulty, an objective to be attained, alternative means of achieving it, doubt about the best alternative, and an environment in which the difficulty occurs.

Identification of a Research Problem

Identification is the stage of **finding and selecting** a problem worth researching.

Sources from which research problems arise:

- **Personal experience and observation** of everyday situations.
- **Review of literature** — books, journals, and earlier studies that reveal gaps or unresolved questions.
- **Theory** — testing, extending, or applying an existing theory.
- **Existing/previous research** — replication, or the "suggestions for further study" noted in earlier work.
- **Practical and social problems** faced by institutions, communities, or organisations.
- **Discussions with experts, teachers, and supervisors.**
- **Technological and social change** that raises new questions.

Considerations in selecting a problem (checklist):

- **Interest** — the researcher should be genuinely interested in the topic.
- **Novelty** — an overdone subject should generally be avoided; the problem should add something.
- **Feasibility** — it must be manageable within the available time, money, and resources.
- **Data availability** — relevant data and sources should be accessible.
- **Competence** — the researcher should have (or be able to acquire) the knowledge and skills needed.
- **Significance** — the problem should be useful, either adding to knowledge or helping solve a practical issue.
- **Ethical acceptability** — it should not harm participants or violate ethical norms.

Formulation of a Research Problem

Once a broad problem area is identified, it must be **formulated** narrowed and stated precisely so that it can be researched. Formulation converts a general idea into a specific, workable statement.

Steps in formulating a research problem:

1. **State the broad problem/subject area** — begin with a general field of interest (e.g., "student learning").
2. **Understand the problem thoroughly** — discuss it with experts and read around it to grasp its background and scope.
3. **Narrow (delimit) the problem** — reduce the broad area to a specific, focused issue by fixing its boundaries (population, place, time, aspect). Example: "the effect of online classes on the concentration of first-year students in college X."
4. **Define key terms and concepts** clearly, so there is no ambiguity about what is being studied.
5. **Identify the variables** involved (independent, dependent) and their possible relationships.
6. **Formulate research questions and/or objectives** that the study will answer.
7. **State hypotheses** where appropriate — tentative, testable statements about the expected relationship.
8. **Rephrase into a final problem statement** — a clear, concise, and researchable statement of the problem.

Techniques that help formulation: funnelling from broad to narrow, reviewing literature to sharpen focus, and preparing a written problem statement that others can read and evaluate.

Characteristics of a Well-Formulated Research Problem

A good research problem statement is often remembered by the word **FINER**:

- **F — Feasible:** manageable within available time, resources, and skills.
- **I — Interesting:** engaging to the researcher and to others.
- **N — Novel:** it adds something new, or confirms/extends earlier findings.
- **E — Ethical:** it can be studied without harming participants.
- **R — Relevant:** it is significant to knowledge, practice, or policy.

In addition, a well-formulated problem is **clear and unambiguous, specific and focused, researchable** (can be answered with data), and states the **variables and their relationship**.

Common Difficulties and Errors

Students often struggle with problem formulation. Typical mistakes include: choosing a problem that is **too broad** or **too narrow**; stating it in **vague or ambiguous** terms; selecting a problem for which **data are not available**; ignoring **feasibility** (time, cost, access); overlooking **ethical** concerns; and beginning data collection before the problem is clearly defined. Careful reading of the literature and discussion with a supervisor help avoid these errors.

Summary

The research problem is the foundation of any study. **Identification** is the process of finding and selecting a suitable problem — drawing on personal experience, literature, theory, and practical needs, while checking interest, feasibility, data availability, competence, significance, and ethics. **Formulation** is the process of narrowing that broad problem into a precise, researchable statement — by understanding it, delimiting it, defining terms, identifying variables, and framing questions, objectives, and hypotheses. A well-formulated problem is **feasible, interesting, novel, ethical, and relevant (FINER)**, as well as clear, specific, and researchable. Getting this first step right gives the entire research project its direction.

1.6 Formulating Research Questions, Hypotheses, Aims and Objectives

Introduction:

Once a research problem has been identified, it must be translated into clear statements that guide the whole study. Four such statements are central: the **aim**, the **objectives**, the **research question(s)**, and the **hypothesis**. Students often confuse these terms, yet each has a distinct role. Together they turn a broad problem into a precise, workable plan.

A simple way to see how they connect:

Aim (the broad goal) → **Objectives** (the specific steps to reach it) → **Research Questions** (what the study asks) → **Hypothesis** (the testable answer it predicts).

The aim and objectives say *what the study intends to do*; the questions say *what it asks*; the hypothesis says *what it expects to find*.

Research Aim

The **aim** is a single, broad statement of the overall purpose or intention of the research — what the study hopes to achieve in general terms. There is usually **one aim** per study.

- It is broad, general, and directional.
- It often begins with words like "to explore," "to investigate," "to examine," "to understand," "to assess."

Example: *"The aim of this study is to investigate the effect of online learning on the academic performance of undergraduate students."*

Research Objectives

Objectives break the aim down into specific, measurable, and achievable steps. They state precisely what the researcher will do to accomplish the aim. A study usually has **several objectives** (often three to five). Objectives are commonly written to be **SMART**:

- **S — Specific:** clearly focused on one thing.
- **M — Measurable:** progress or achievement can be assessed.
- **A — Achievable:** realistic with the available resources.
- **R — Relevant:** connected to the aim.
- **T — Time-bound:** achievable within the study period.

They usually begin with action verbs such as *to identify, to measure, to compare, to determine, to analyse, to evaluate*.

Example objectives (for the aim above):

1. To measure the average study time of students in online and offline modes.
2. To compare the examination scores of the two groups.
3. To identify the main difficulties students face in online learning.

Aim vs. Objectives: the aim is the destination; the objectives are the individual steps of the journey. One broad aim; several specific objectives.

Research Questions

A **research question** is the specific question that the study seeks to answer. It converts the problem and objectives into an interrogative form and gives the research a clear focus.

Types of research questions:

- **Descriptive** — *what is happening?* (e.g., "What proportion of students prefer online classes?")
- **Relational/Correlational** — *is there a relationship?* (e.g., "Is there a relationship between hours of online study and examination scores?")
- **Causal** — *does one thing cause another?* (e.g., "Does online learning improve academic performance?")

Characteristics of a good research question are captured by **FINER**: Feasible, Interesting, Novel, Ethical, Relevant. A good question is also clear, specific, focused, and answerable with data. (Qualitative studies favour broad, open "how/why" questions; quantitative studies favour narrower questions about variables and relationships.)

Hypothesis

A **hypothesis** is a tentative, testable statement that predicts the relationship between two or more variables. It is, in effect, a proposed *answer* to the research question, stated so that it can be tested with data. Hypotheses are used mainly in **quantitative** research; purely exploratory or qualitative studies often use research questions instead.

Types of hypotheses:

- **Null hypothesis (H_0):** states that there is *no* relationship or difference (e.g., "There is no significant difference in the scores of online and offline learners"). It is the statement tested statistically.
- **Alternative hypothesis (H_1 or H_a):** states that there *is* a relationship or difference (e.g., "Online learners score significantly higher than offline learners").
- **Directional hypothesis:** predicts the direction of the relationship ("higher," "lower," "increase," "decrease").
- **Non-directional hypothesis:** predicts a relationship but not its direction ("there is a difference").

Characteristics of a good hypothesis: it is clear and specific; testable/empirically verifiable; states a relationship between variables; is consistent with known facts; and is as simple and concise as possible.

Variables to note: the **independent variable** is the presumed cause (e.g., mode of learning); the **dependent variable** is the presumed effect (e.g., academic performance).

How the Four Relate — A Worked Example

Problem: Concern about whether online learning helps or harms undergraduate performance.

- **Aim:** To investigate the effect of online learning on the academic performance of undergraduate students.
- **Objective:** To compare the examination scores of students taught online with those taught in person.
- **Research question:** Does online learning affect the academic performance of undergraduate students?

- **Hypothesis (H_1):** Students taught online score significantly differently from students taught in person. (H_0 : There is no significant difference in their scores.

Comparison Table

Element	What it is	Number	Nature	Typical wording
Aim	The broad overall purpose	Usually one	General, directional	"To investigate...", "To explore..."
Objectives	Specific steps to achieve the aim	Several (3–5)	Specific, measurable (SMART)	"To measure...", "To compare..."
Research question	What the study asks	One or a few	Interrogative, focused (FINER)	"What...?", "Is there...?", "Does...?"
Hypothesis	A testable predicted answer	One or more	Declarative, testable	"There is a significant difference..."

Summary

The aim states the broad purpose of a study; the objectives break that aim into specific, SMART steps; the research questions express what the study asks in interrogative form; and the hypothesis states a tentative, testable answer predicting the relationship between variables. Aims and objectives are used in nearly all research; research questions guide both qualitative and quantitative work; hypotheses belong mainly to quantitative, hypothesis-testing studies. Formulating all four clearly — moving logically from general aim to specific, testable statements — gives a research project focus, direction, and a clear standard against which its success can be judged.

Probable Questions

A. Short answer / Very short answer type questions (2-5 marks)

1. Define research. Name any three bases on which research is classified.
2. Differentiate between basic and applied research with one example each.
3. What is experimental research? Name its two essential groups.
4. Define descriptive research and give one example.
5. What is the main purpose of exploratory research?
6. List any two tools used in survey research.
7. How does qualitative research differ from quantitative research?
8. Define research approach, research method, and research methodology in one sentence each.
9. Distinguish between the quantitative and qualitative research approaches.

10. What is the difference between deductive and inductive reasoning in research?
11. State any three research methods of data collection.
12. Why are methods said to be a "part" of methodology?
13. List the main stages of the research process in sequence.
14. What is meant by a research design? Why is it important?
15. Define a hypothesis and give one example.
16. State any four criteria of good research.
17. What is meant by the "iterative" nature of the research process?
18. What is a research problem? State its main components.
19. List any four sources of a research problem.
20. Differentiate between identification and formulation of a research problem.
21. What does the acronym FINER stand for?
22. Mention any three points to consider while selecting a research problem.
23. Distinguish between the aim and the objectives of a research study.
24. What is a hypothesis? State any two of its characteristics.
25. Differentiate between the null hypothesis and the alternative hypothesis.
26. What does the acronym SMART stand for in relation to objectives?
27. Give one example each of a descriptive and a causal research question.

B. Long-answer (8–10 marks)

1. Explain the various types of research with suitable examples.
2. Distinguish between basic and applied research. Discuss their importance in the advancement of knowledge.
3. Describe experimental research. Explain the roles of the independent variable, dependent variable, and control in establishing cause-and-effect.
4. What is descriptive research? Compare descriptive and exploratory research.
5. Discuss survey research as a method of data collection, stating its merits and limitations.

6. Compare qualitative and quantitative research and explain when qualitative methods are appropriate.
7. "Research methods and research methodology are not the same." Discuss this statement with suitable examples.
8. Explain the various research approaches and illustrate when each is appropriate.
9. Describe the relationship between research approach, methodology, and methods using an example of your own.
10. What do you understand by research methodology? Why is it considered broader than research methods?
11. Prepare a comparative table distinguishing research methods from research methodology and explain each point of difference.
12. Describe the various stages of the research process with a suitable example.
13. Explain the criteria of good research. Why is objectivity important?
14. "Research is a systematic process." Discuss with reference to its stages.
15. Distinguish between reliability and validity as criteria of good research.
16. Why is the review of literature considering an essential stage of research?
17. Explain the steps involved in formulating a research problem with a suitable example.
18. Discuss the various sources from which a research problem may be identified.
19. What are the characteristics of a well-formulated research problem?
20. "Defining a research problem is the most important step in research." Discuss.
21. Describe the difficulties commonly faced in identifying and formulating a research problem, and how they can be overcome.
22. Explain the difference between a research question and a hypothesis with suitable examples.
23. What are the characteristics of a good hypothesis? Discuss the different types of hypotheses.
24. Describe the relationship between aim, objectives, research questions, and hypothesis using an example of your own.
25. Explain how research objectives should be framed. Why should they be SMART?
26. "A hypothesis is a tentative answer to a research question." Discuss with reference to types of hypotheses.

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