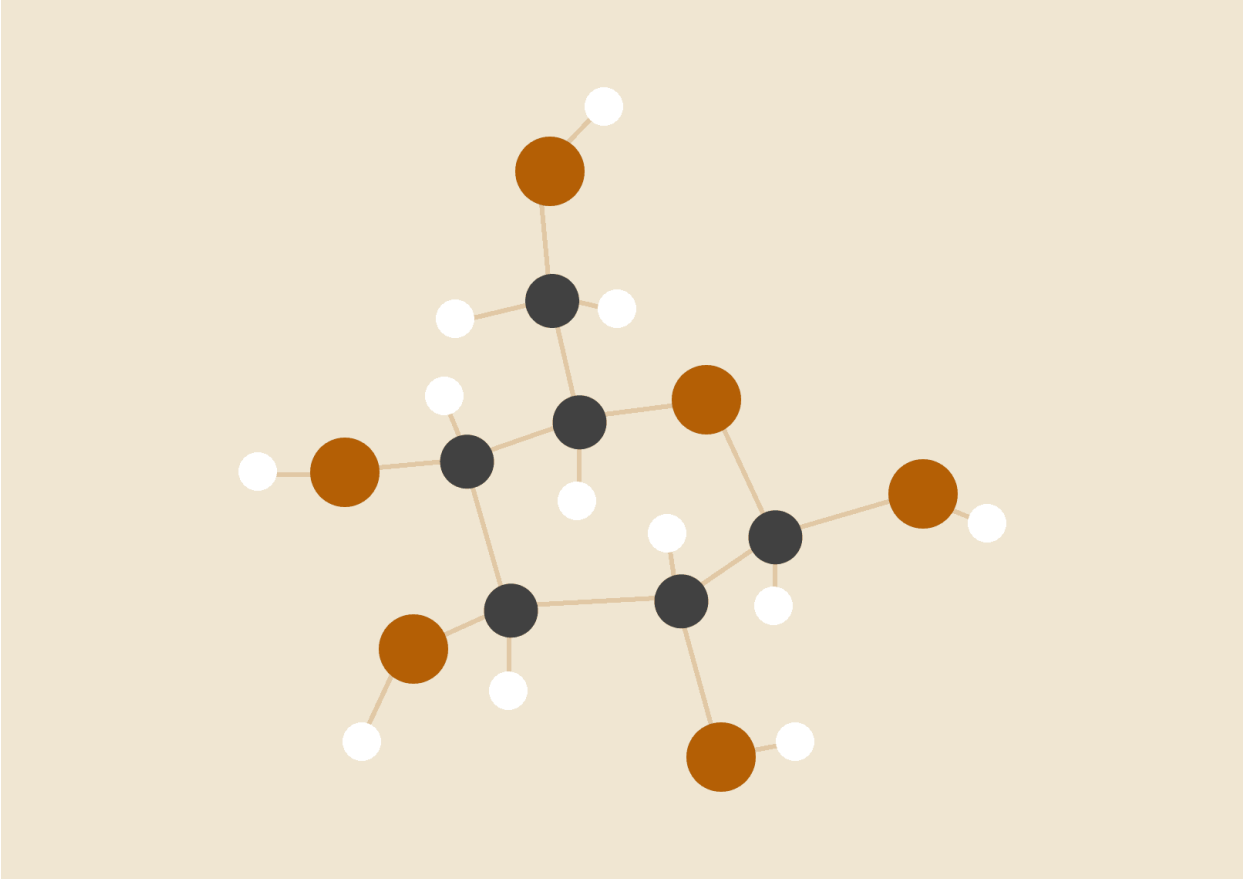
RSM354 Research Methodology

Course Note



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B.Sc. CSIT (Computer Science and Information Technology)

Course Description:

This course introduces the concepts of research methodology. It also emphasizes formulating research questions, conducting literature review, data collection, data analysis based on research questions, and other various ethical issues, plagiarism.

Course Objectives:

This course focuses on the concept of research methodology; research design, formulation of research questions, process of review of literature, methods of data collection, measurement issues, ethical issues, plagiarism, data analysis, and interpretations. After completion of the course, students will also be able to prepare a mini-research report following standard notions of research methodology.

Unit 1: Introduction to Research Methodology (4 Hrs.)

1.1 Meaning

Research is fundamentally a systematic and scientific pursuit of knowledge or pertinent information about a specific topic. It can be seen as both an art of investigation and an academic activity. The **Advanced Learner's Dictionary** defines research as "a careful investigation or inquiry, especially through a search for new facts in any branch of knowledge," while Redman and Mory describe it as a "systematized effort to gain new knowledge." Research is often viewed as a journey from the known to the unknown, driven by our inherent curiosity.

Clifford Woody outlines research as a process that includes identifying problems, developing hypotheses, collecting and organizing data, analyzing information, drawing conclusions, and rigorously testing these conclusions. **Slesinger and Stephenson** add that research involves manipulating concepts or symbols to generalize or verify knowledge, contributing to theoretical or practical advancements. Overall, research seeks truth through structured and objective methods, aiming to solve problems or build theoretical frameworks through observation, experimentation, and comparison.

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1.2 Objectives of Research

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

1. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed *exploratory* or *formulative* research studies);

2. To portray accurately the characteristics of a particular individual, situation, or group (studies with this object in view are known as *descriptive* research studies);

3. To determine the frequency with which something occurs or with which it is associated
with something else (studies with this object in view are known as *diagnostic* research studies);

4. To test a hypothesis of a causal relationship between variables (such studies are known as *hypothesis-testing* research studies).

1.3 Motivations in Research

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:
1. Desire to get a research degree along with its consequential benefits;
2. Desire to face the challenge in solving unsolved problems, i.e., concern over practical problems initiates research;
3. Desire to get intellectual joy of doing some creative work;
4. Desire to be of service to society;
5. Desire to get respectability.

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations.

1.4 Concepts of deductive and inductive theory

The concepts of **deductive** and **inductive** theory are two fundamental approaches to reasoning and research:

1. **Deductive Theory**: This approach begins with a general idea or theory and uses logic to derive specific hypotheses or predictions. It follows a "top-down" method. In this case, researchers start with an existing theory, formulate a hypothesis, collect data, and analyze results to confirm or refute the original hypothesis. For example, if a theory states that all swans are white, a deductive approach would test this by observing swans to confirm or disprove the claim.
2. **Inductive Theory**: This approach starts with specific observations and moves toward generalizations and theories. It is a "bottom-up" method where researchers collect data, identify patterns, and develop a broader theory based on the findings. For instance, observing that several swans are white may lead to the inductive generalization that all swans are white.

In essence, **deductive reasoning** moves from general to specific, while **inductive reasoning** moves from specific to general.

1.5 Characteristics of Scientific Method

The scientific method is a systematic approach to understanding the natural world. It involves a series of steps that are designed to ensure objectivity and accuracy. Here are the key characteristics of the scientific method:

1. Empirical:

- Relies on observation and experimentation.
- Data is collected through senses or instruments.
- Focuses on observable phenomena.

2. Objective:

- Aims to be unbiased and free from personal opinions or beliefs.
- Uses standardized methods and procedures.
- Strives for reproducibility of results.

3. Systematic:

- Follows a structured approach with clear steps.
- Involves careful planning and execution.
- Organizes information and analysis in a logical manner.

4. Verifiable:

- Results can be confirmed by other researchers.
- Data and methods are transparent and open to scrutiny.
- Encourages peer review and critical evaluation.

5. Predictive:

- Aims to explain past events and predict future ones.
- Uses theories and models to make forecasts.
- Tests predictions through further experimentation.

6. Tentative:

- Scientific knowledge is always open to revision.
- New evidence can lead to modifications or rejection of theories.
- Embraces a spirit of inquiry and skepticism.

7. Self-correcting:

- Errors and inconsistencies are identified and corrected.
- New findings can challenge and improve existing knowledge.
- Promotes continuous learning and refinement.

By following these characteristics, the scientific method helps ensure that scientific knowledge is reliable, accurate, and evidence-based.

Research and Scientific method

The **scientific method** is a systematic approach used in research to ensure accurate and logical conclusions. It is based on observation, experimentation, and logical reasoning. The terms **research** and **scientific method** are interlinked, as research often relies on the scientific method to explore the nature, causes, and consequences of various

phenomena.

Research involves a systematic inquiry aimed at repeatability and generalization, making it applicable to more complex situations. The **scientific method**, as explained by Karl Pearson, emphasizes that all sciences are united by a common approach: the method of logically organizing and classifying facts to understand their relationships and sequences.

The **core components** of the scientific method include:

1. **Experimentation**: Testing hypotheses under controlled conditions.
2. **Observation**: Collecting data to understand phenomena.
3. **Logical Reasoning**: Using logical arguments and postulates to derive conclusions.

This method involves formulating clear and testable propositions, considering possible alternatives, and comparing these with observations to determine which aligns best with the observed data. The goal is to establish a systematic interrelation of facts and uncover the truth based on evidence and logical analysis.

1.6 Understanding the concepts of concepts, constructs, and variables

Understanding the concepts of concepts, constructs, and variables is essential in the research process, as they form the foundational elements for designing studies and interpreting data. Here's a detailed breakdown of each term and their interrelationships:

Concepts

- Definition: A concept is an abstract idea or generalization derived from observing common characteristics among multiple instances. Concepts serve as building blocks for developing hypotheses and theories in research.
- Examples: Common concepts include "justice," "happiness," and "education." These are broad ideas that can encompass various specific instances or phenomena.
- Characteristics: Concepts can be tangible (observable) or intangible (not directly observable). For instance, "height" is a tangible concept, while "intelligence" is intangible.

Constructs

- Definition: A construct is a specific type of concept that is deliberately created or adapted by researchers to explain a particular phenomenon. Constructs are often abstract and not directly measurable.
- Examples: Constructs include "self-esteem," "motivation," and "social anxiety." These constructs represent complex phenomena that cannot be observed directly but can be inferred through measurable indicators.
- Operationalization: To study constructs, researchers must operationalize them, meaning they define how these abstract ideas will be measured using specific variables. For instance, self-esteem might be measured using a questionnaire assessing feelings of self-worth.

Variables

- Definition: A variable is any characteristic or quantity that can be measured or counted. Variables can take on different values across different instances or groups, making them essential for empirical research.
- Examples: Common variables include age, gender, income, and test scores. These are specific measures that can change and are used to quantify constructs.
- Types of Variables: Independent Variables are factors that are manipulated to observe their effect on other variables.Dependent Variables: Outcomes that are measured to see how they are affected by independent variables.Control Variables: Factors kept constant to ensure that any observed effects are due to the independent variable.

Interrelationships

- Concepts provide the broad ideas from which constructs are developed. Constructs, being more specific and tailored for research purposes, help explain phenomena through measurable variables. For example: The concept of "health" could lead to the construct of "physical fitness," which can then be measured using variables like body mass index (BMI), exercise frequency, and dietary habits.

Importance in Research

Understanding these terms is crucial for researchers as they:

- Develop clear hypotheses and research questions.
- Create effective measurement tools that accurately reflect the constructs being studied.
- Ensure that their findings are valid and reliable by appropriately defining and measuring concepts and constructs.

By grasping the distinctions between concepts, constructs, and variables, researchers can better design studies, analyze data, and draw meaningful conclusions about the phenomena they investigate

1.7 Research Process

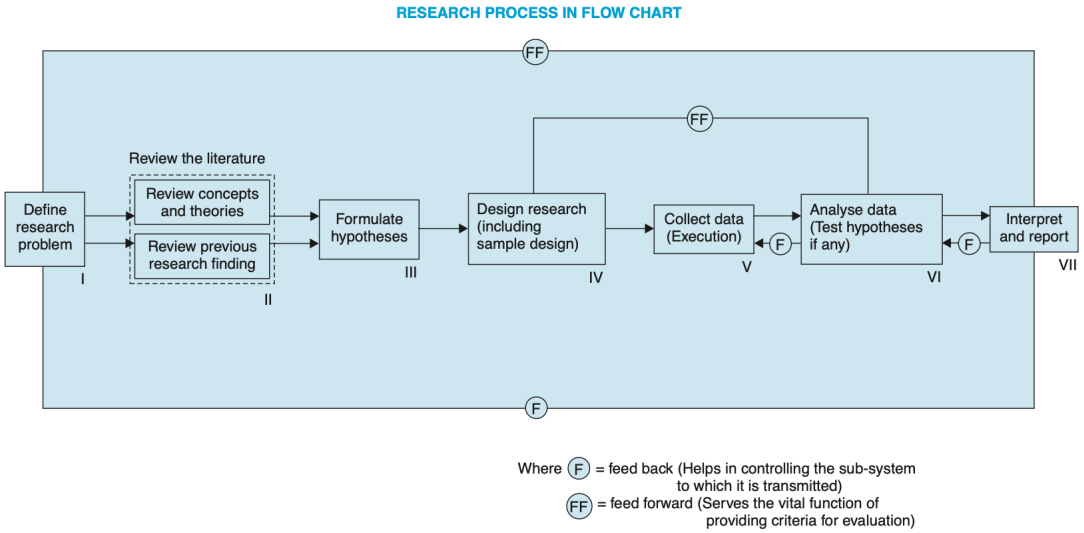

Fig. 1.1

Unit 2: Research Design (6 Hrs.)

2.1 Concept of research design and its importance

A research design is a blueprint for conducting a study, outlining the procedures for data collection, measurement, and analysis. It involves decisions about what, where, when, and how to conduct the research, ensuring relevance to the research purpose while maintaining efficiency. The design serves as the framework for the entire research process, from formulating the hypothesis to analyzing the data.

More explicitly, the design decisions happen to be in respect of:

1. What is the study about?
2. Why is the study being made?
3. Where will the study be carried out?
4. What type of data is required?
5. (v) Where can the required data be found?
6. What periods of time will the study include?
7. What will be the sample design?
8. What techniques of data collection will be used?
9. How will the data be analyzed?
10. In what style will the report be prepared?

Keeping in view the above-stated design decisions, one may split the overall research design into
the following parts:

(a) *the sampling design* which deals with the method of selecting items to be observed for the
given study;

(b) *the observational design* which relates to the conditions under which the observations
are to be made;

(c) *the statistical design* which is concerned with the question of how many items are to be observed and how the information and data gathered are to be

analyzed; and

(d) *the operational design* which deals with the techniques by which the procedures specified
in the sampling, statistical and observational designs can be carried out.
From what has been stated above, we can state the important features of a research design as
under:

(i) It is a plan that specifies the sources and types of information relevant to the research
problem.

(ii) It is a strategy specifying which approach will be used for gathering and analyzing the data.

(iii) It also includes the time and cost budgets since most studies are done under these two
constraints.
In brief, research design must, at least, contain—(a) a clear statement of the research problem;

(b) procedures and techniques to be used for gathering information; (c) the population to be studied;
and (d) methods to be used in processing and analyzing data.

2.2 Concept of research design and its importance

Research design is essential for efficient research operations, ensuring maximum information with minimal effort, time, and cost.
Comparable to a blueprint for constructing a house, a research design is a well-thought-out plan for data collection and analysis.
Advance planning involves selecting appropriate methods for data collection and techniques for analysis, considering the research objectives, and available resources (staff, time, and money).
Careful preparation of the research design is crucial; errors in the design can disrupt the entire project.

The reliability of research results depends heavily on a well-structured research design, serving as the foundation for the entire study.

Many researchers overlook the importance of a well-thought-out research design, which can lead to misleading conclusions and an unsuccessful research outcome.

Thoughtless design can render a research project futile and prevent it from serving its intended purpose.

A proper design helps organize the researcher's ideas, allowing for the identification of flaws and inadequacies before beginning the research.

Sharing the design with others for feedback and critical evaluation is essential for improving the quality of the research.

Without such a plan, it becomes difficult for others to provide a comprehensive review or critique of the proposed study.

2.3 Features of a Good Research Design

Characteristics of a good design: flexible, appropriate, efficient, and economical.

A good design minimizes bias, maximizes data reliability, and minimizes experimental errors.

Maximizing information and providing opportunities to explore different aspects of a problem are key features of an efficient design.

The suitability of a design depends on the research problem's objective and nature; a design that works well for one problem may not be suitable for another.

Factors influencing a research design:

1. Means of obtaining information.
2. Availability and skills of the researcher and staff.
3. Objective of the research problem.
4. Nature of the problem to be studied.
5. Availability of time and money.

Exploratory/Formulative research: Requires a flexible design to allow the discovery of ideas and insights, considering multiple aspects of a phenomenon.

Descriptive research: Focuses on accuracy and minimizing bias, with an emphasis on reliable evidence for accurate descriptions or associations between variables.

Hypothesis-testing research: Needs a design that allows for causal inferences while also minimizing bias and maximizing reliability.

Research categorization: Many studies may include elements of exploratory, descriptive, and hypothesis-testing approaches, making categorization difficult. The primary function of the study help determine its classification.

Factors influencing research design:

1. Availability of time and money.
2. Skills of the research staff.
3. Means of obtaining information.

These factors must be considered when choosing between experimental, survey, or sample designs.