CHAPTER - ONE

Introduction and Overview of Research

1. Definition and Purpose of Research

1.1 Scientific Research Defined

- Research is defined as human activity based on intellectual application in the investigation of matter,i.e to develop the ability to think.
- *It is the systematic process of collecting and analyzing information to increase our understanding of the phenomenon under study.*
- It may be said that the general aims of research are to observe and describe, to predict, to determine causes and explain.
- **A research may be considered as a systematic and objective investigation that involves systematic, design, collection, preparation, interpretation and reporting of information needed to solve specific problems or promote a domain of learning**

1.2 Scientific Research Explained

- **Scientific research is performing a methodical(systematic) study in order to prove a hypothesis (answer a specific question).**
- Research must be systematic and follow a series of steps and a rigid standard protocol.
- Research is:
- **Systematic** - so ordered, planned and disciplined;
- **Controlled** - the researcher can have confidence in his/her research outcomes;
- **Empirical** - putting beliefs, ideas, or assumptions to a test ,and
- **Critical** – Many truths are tentative & are subject to change as a result of subsequent research.

1.3 Characteristics of Scientific Research

- main characteristics of research are summarized as follows. Research:
  - is directed toward the solution of a problem
  - is based upon observable experience or empirical evidence;
  - demands accurate observation and description;
  - involves gathering new data from primary sources or using existing data for a new purpose;
  - is characterized by carefully designed procedures, always applying rigorous(exact) analysis. However, it is sometimes somewhat random and unsystematic;
  - requires knowledge;
  - is carefully recorded and reported;
  - emphasizes the development of generalizations, principles, or theories that will be helpful in predicting future occurrences.

1.4 Goals of Scientific Research

- The purpose of scientific research is problem solving.
- The problem could be of an immediate and practical value or they could be of theoretical nature.
- Researchers attempt to reduce the complexity of problems.
- Seeking solutions to practical or theoretical problems involves doing the following important tasks:
  - Describing phenomena ➔ answers "who", "what", "where"
  - Explaining phenomena ➔ cause & effect r/n b/n phenomenon
  - Predicting phenomena ➔ what will happen in future
  - Controlling phenomena ➔control ➔ to intervene subsequently
  - Comparing phenomena ➔ comparing groups on one behaviour

Reading Assignment

➔ Philosophy of Research in Computing!!!

1.5 Objectives, Motivations and Significance of Research

- **OBJECTIVES OF RESEARCH**
  - The purpose of research is to discover answers to questions through the application of scientific procedures.
  - The main aim of research is to find out the truth which is hidden and which has not been discovered as yet.

1.5 Objectives, Motivations and Significance of Research

- **OBJECTIVES OF RESEARCH … cont'd**

- 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
2. To describe accurately the characteristics of a particular individual, situation or a group
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 causal relationship between variables

1.5 Objectives, Motivations and Significance of Research

- **MOTIVATION 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 the 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.

1.5 Objectives, Motivations and Significance of Research

- **SIGNIFICANCE OF RESEARCH**

The significance of research can also be understood keeping in view the following points:

(a) To those students who are to write a master's or Ph.D. thesis, research may mean a careerism or a way to attain a high position in the social structure;

(b) To professionals in research methodology, research may mean a source of livelihood;

(c) To philosophers and thinkers, research may mean the outlet for new ideas and insights;

1.5 Objectives, Motivations and Significance of Research

- **SIGNIFICANCE OF RESEARCH … cont'd**

(d) To legendary men and women, research may mean the development of new styles and creative work;

(e) To analysts and intellectuals, research may mean the generalizations of new theories.

Thus, research is the fountain of knowledge for the sake of knowledge and an important source of providing guidelines for solving different :

- ✓ Business,
- ✓ Governmental and
- ✓ Social problems.

1.6 Classification of Research

- There are different ways of classifying research.
- It is really difficult to propose a single classification method that fits different disciplines and is acceptable by all.
- For example some classify research as
  - ✓ Theoretical/Basic/ and Applied research
  - ✓ Descriptive, Explanatory and Exploratory research
  - ✓ Quantitative and Qualitative research
  - ✓ Experimental, Quasi-experimental and Non-experimental Research
  - ✓ Primary and Secondary Research
  - ✓ And other research

Classification… cont'd

Research can be classified in terms of:

- goal of research,
  - Theoretical/Basic/ and
  - Applied research
- specific objectives of research,
  - Descriptive,
  - Explanatory and
  - Exploratory research
- designs,
  - Experimental,
  - Quasi-experimental and
  - Non-experimental Research
- approaches of research,
  - Quantitative and
  - Qualitative research
- the type of data used in research,
  - Primary and
  - Secondary Research
- fields of study.
  - Engineering
  - Natural science
  - Health Science Research, *etc.*

Basic vs. Applied Research

- Recall that goal of research is ⟹ problem solving.
- The nature of the problem that the research attempts to solve could be
  - ***theoretical*** – building a theory

    or
  - ***practical*** – solving immediate practical problems.
- **Basic/Pure/Fundamental Research**
  - is about explaining the world around us and trying to understand how the universe operates.
  - It is a direct descendent of philosophy

Basic… Cont'd

- primary objective is **advancement of knowledge** and **the theoretical understanding** of the relations among variables.
- It is basically concerned with the **formulation of a theory** or a **contribution** to the existing body of knowledge.
- designed to add to an organized body of scientific knowledge & *does not necessarily produce results of immediate practical value*

Basic… Cont'd

- **Applied Research**
  - Is designed to solve **practical problems** of the modern world, rather than to acquire knowledge for knowledge's sake. Ex. *'Is global warming avoidable?*
  - One might say that the goal of the applied scientist is to improve the human condition.
  - Its purpose is about testing theories, often generated by pure science, and applying them to real situations, addressing more than just abstract principles.

Descriptive, Explanatory and Exploratory Research

- Research also addresses specific objective.
- The objective could be
  - describing a phenomenon of interest or
  - explaining causal link between two variables or
  - you may be interested in better understanding and clarifying of a particular phenomenon.

Descriptive… Cont'd

- **Descriptive Research**
  - sets out to describe and to interpret ***what is***.
  - The researcher has no control over the variables; i.e. He/she can only report what has happened or what is happening. For example, frequency of shopping, preferences of people, or similar data.
  - Research methods that come under descriptive research are:
    - *Surveys*
    - *correlation studies*
    - *observation studies*
    - *case studies*

Descriptive… Cont'd

- **Explanatory/Analytical Research**
  - aims at establishing the ***cause and effect relationship*** between variables.
  - The desire to know ***"why"***, to explain, is the purpose of explanatory research.
  - It can be taken as a continuation of descriptive research to identify the reasons for something that occurs.

Descriptive… Cont'd

- **Exploratory Research**
  - It focuses on gaining background information and helps to better understand and clarify a problem.
  - It is conducted when there ***are few or no earlier studies*** to which references can be made for information.
  - It provides insights into and comprehension of an issue or situation for more rigorous investigation later.
  - It can be said that exploratory research is generally a predecessor to a more formal study.

Qualitative vs. Quantitative Research

- **Qualitative Research**
- social and behavioural sciences where the aim is to discover the underlying motives of social/human behavior
- phenomena relating to or involving ***quality or kind***. It is attitude or opinion research.
- It involves studies that ***do not attempt to quantify their results through statistical summary or analysis***.
- Here, data are often in the *form of descriptions, not numbers.*
- It typically involves **in-depth interviews, group discussions, artefact studies, projective techniques, and observations** without formal measurement

Qualitative vs… Cont'd

- **Quantitative Research**
- "hard science" disciplines
- It is based on the ***measurement of quantity or amount***.
- It is applicable to phenomena that can be expressed in terms of quantity.
- The objective of quantitative research is to develop and employ ***mathematical models, theories and hypotheses*** pertaining to natural phenomena.
- The process of ***measurement*** is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of an attribute

Experimental, Quasi-experimental and non-experimental

- Once the researcher has determined the specific question to be answered and has operationalized the variables and research question into a clear, measurable hypothesis, *the next task is to consider a suitable research design*.
- **Experimental Research**
  - involves comparing two groups on one ***outcome measure to test*** some hypothesis regarding causation.

Primary vs. Secondary Research (based on type of data)

- Depending on the type of data generated and used, research can be classified as Primary research (also called field research) and Secondary research (also known as desk research)
- **Primary research**
  - involves the collection of data that does not already exist
- **Secondary research**
  - involves the summary, collation and/or synthesis of existing data rather than generating primary data where data are collected from, for example, research subjects or experiments.

Research Methods

- Research methods may be understood as all those methods/techniques that are used for conduction of research.
- Research methods or techniques refer to the methods the researchers use in performing research operations.
- In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods.

Research Methods

Keeping this in view, research methods can be put into the following three groups:

1. In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;

2. The second group consists of those statistical techniques which are used for establishing

relationships between the data and the unknowns;

3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained.

Effective Report Writing Principles

- Checklist for good reports
  - Does it answer the purpose stated (or implied) in the brief?
  - Does it answer the needs of the projected reader?
  - Has the material been placed in the appropriate sections?
  - Has all the material been checked for accuracy?
  - Are graphs and tables carefully labeled?
  - Is data in graphs or tables also explained in words and analyzed?
  - Does the discussion/conclusion show how the results relate to objectives set out in the introduction?
  - Has all irrelevant material been removed?
  - Is it jargon-free and clearly written?

Effective Report Writing Principles

- Checklist for good reports … con't

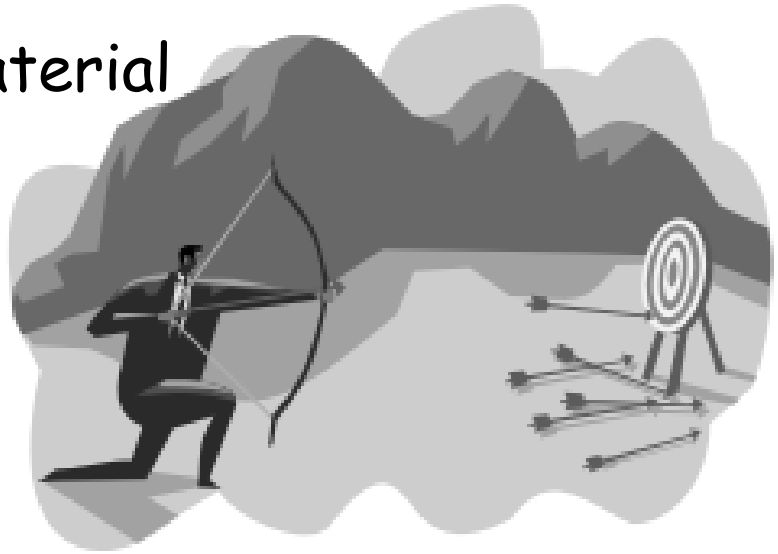
- Is it written throughout in appropriate style (i.e. no colloquialisms or contractions, using an objective tone, specific rather than vague)?
- Has every idea taken from or inspired by someone else's work been acknowledged with a reference?
- Have all illustrations and figures taken from someone else's work been cited correctly?
- Has it been carefully proof-read to eliminate careless mistakes?

Effective Report Writing Principles

- What makes a good/bad report?

Here are some of the most common complaints about reports:

- Badly structured
- Inappropriate writing style
- Incorrect or inadequate referencing
- Doesn't answer the brief
- Too much/too little/irrelevant material
- Expression not clear
- Doesn't relate results to purpose



Effective Report Writing Principles

- How can you make sure your report does what it's meant to do, and does it well?

Top tip…

- ✓ The most important thing to do is **read the brief** (or the title of your assignment, or your research question) carefully.
- ✓ Then **read it again even more carefully**!
- ✓ If you're still not completely clear about what to do, talk to your tutor or a Study Adviser – **don't guess**.

Criteria for Good Research

- One expects scientific research must satisfy the following criteria:

1. The purpose of the research should be clearly defined
2. The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement.
3. The procedural design of the research should be carefully planned
4. The researcher should report with complete frankness and flaws in procedural design.
5. The analysis of data should be sufficiently adequate to reveal its significance. The validity and reliability of the data should be checked carefully.

Criteria for Good Research

- One expects scientific research must satisfy the following criteria: … Con't

6. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.
7. Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

Evaluating and Reviewing Research Results

- Evaluating Research refers to the process of assessing the quality, credibility, and relevance of a research study or project.
- This involves examining the methods, data, and results of the research in order to determine its validity, reliability, and usefulness.
- Evaluating research can be done by both experts and non-experts in the field, and involves critical thinking, analysis, and interpretation of the research findings.

Research Evaluating Process

- Identify the Research Question
  - The first step in evaluating research is to identify the research question or problem that the study is addressing.
- Assess the Study Design
  - The study design refers to the methodology used to conduct the research.
  - You should assess whether the study design is appropriate for the research question and whether it is likely to produce reliable and valid results.
- Evaluate the Sample
  - It is the group of participants who are included in the study.
  - You should evaluate whether the sample size is adequate and whether the participants are representative of the population under study.

Research Evaluating Process

- Review the Data Collection Methods
  - Review the data collection methods used in the study to ensure that they are valid and reliable.
  - This includes assessing the measures used to collect data and the procedures used to collect data.
- Examine the Statistical Analysis
  - Statistical analysis refers to the methods used to analyze the data.
- Assess the Conclusions
  - Evaluate whether the data support the conclusions drawn from the study and whether they are relevant to the research question.
- Consider the Limitations
  - Finally, you should consider the limitations of the study, including any potential biases or confounding factors that may have influenced the results.

Research in Computing

- In Computing, Some areas of research are theoretical and involve developing and analyzing new algorithms and techniques,
- while some are more applied and involve experiments, design, implementation, and testing.
- In any case, research is an enterprise of intellectual exploration that seeks to advance computing field.
- Some of the research areas in computer science include: Artificial Intelligence (AI), Computer Architecture & Engineering, Biosystems & Computational Biology, Cyber-Physical Systems and Design Automation, Database Management Systems, Education, Graphics, Systems and Networking