Introduction to Research Methodology

Lecture 1:

Research Methodology: A review of the Fundamentals

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Objectives

- At the end of the theme, you should be able to:
  - Explain what research is and what it is not, and the different **definitions** of research;
  - Introduce the **objectives** of research, and set the **motivation** in research;
  - Discuss the **criteria of good research**

Content

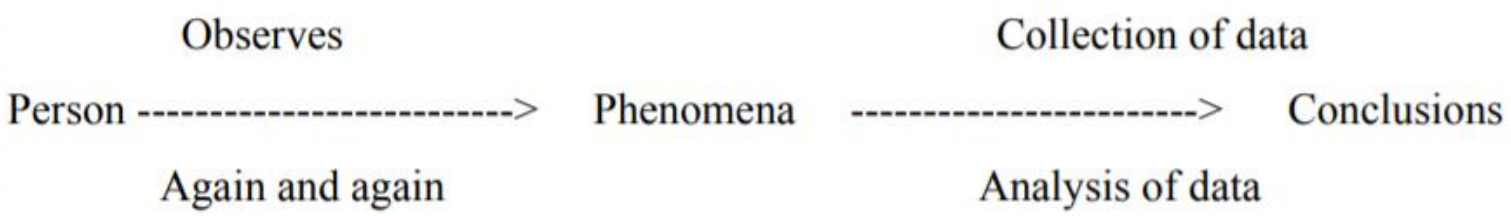
1. Meaning of Research
2. Definitions of Research
3. Objectives of Research
4. Motivation in Research
5. General Characteristics of Research
6. Criteria of good Research

1. Meaning of Research

- Research seeks **the answer of certain questions** which have **not yet been answered so far**
- It refers to a **search for knowledge**
- Research is **a careful investigation or inquiry**
  - **Search for new facts in any branch of knowledge**
- In this sense, **it is a voyage of discovery and curiosity** to attain **full and fuller understanding of the unknown.**

2. Definition of Research

- The term '**research**' consists of **two words**: Research: **Re+ search**
  - '**Re**' means **again and again** and
  - '**search**' means to **find out something**
- The following is the **process**:



- Therefore, **research** means to **observe the phenomena again and again from different dimensions**. It is a process of which **a person**
  - **observes the phenomena again and again**
  - **collects data**
  - **on the basis of data s/he draws some conclusions.**

2. Definition of Research

- Research is oriented towards the **discovery of relationship** that exists **among phenomena** of the world in which we live.
- According to **P.D. Leedy** "Research is **the manner in which we solve knotty= difficult problems** in an attempt to push back the frontiers of human ignorance.
- Research is ultimately **a way of thinking**. It is a way of looking at **accumulated facts** so that a collection of data speaks to the mind of the researcher".
- **A fact is** a thing that is known or proved to be true: An **example** of a **fact** is that **the world is round**.

2. Definition of Research

- **Research** has **many discrete characteristics** which include the following:
  - Research **begins with a question in the mind of the researcher.**
  - Research demands the **identification of a problem**, stated in **clear**, **unambiguous terms.**
  - Research requires a **plan.**
  - Research **deals with the main problem through appropriate sub-problems.**
  - Research **seeks direction through appropriate hypotheses** and is based upon obvious **assumption.**
  - Research deals with **facts.**

2. Definition of Research

- According to **P.M. Cook** "Research is an **honest**, **exhaustive= complete and comprehensive**, **intelligent searching for fact and their meanings or implications** with **reference to a given problem**.
- The **product** of findings of a given piece of research should be an **authentic= true and reliable**, **verifiable**, and **contribution to knowledge in the field studied**".

2. Definition of Research

- He has emphasized the following **characteristics** of research :
  - It is an **honest** and **exhaustive** process.
  - The **facts** are studied with **understanding**.
  - The **facts** are discovered in the light of a **problem** → **Research is problem- centered**.
  - The **findings** are **valid** and **verifiable**.
  - Research work should **contribute new knowledge in that field**.

2. Definition of Research

- **Research** is divided into **two general categories**:
  1. **Basic research**: is inquiry aimed at **increasing scientific knowledge: research** that **fills in the knowledge we don't have**; it tries to learn things that aren't always directly applicable or useful immediately, and
  2. **Applied research** is effort aimed at **using basic research** for **solving problems** or **developing new processes**, **products**, or **techniques**.

3. 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 f**ind out the truth which is hidden** and **which has not been discovered yet.**
- *Kothari* (1990) sees that **each research study has its own specific purposes.** Some examples of these are as follows:
  - To **gain familiarity with a phenomenon** or to **achieve new insights into it** → termed **exploratory** or **formulative research studies**.
  - To **represent accurately the characteristics of a particular individual, situation or a group** → known as **descriptive research studies**.

3. Objectives of research

- To **determine the frequency with which something occurs** or **with which it is associated with something else** → known as **diagnostic research studies**.
- To **test a hypothesis** of a causal relationship between variables. Studies with this object are known as **hypothesis-testing research studies**.

- On the same issue, **Singh (2006) provides a different classification of objectives**. For him, there are **three fundamental objectives of research**. These are:

Theoretical Objectives

- Those researches whose objectives are theoretical **aim to formulate new theories, principles**, or **laws**.
- Such type of research is **exploratory** because it **explains the relationships of certain variables**.
- The researches **contribute some basic knowledge to the human knowledge**.

Factual Objectives

- These researches whose objectives are **factual** aim to **find out new facts**.
- This objective by nature is **descriptive**.
- These researches **describe facts** or **events** which **happened previously**.
- Such type of research is **done in history**

Application objectives

- The research having **application objectives does not contribute a new knowledge** in the field of human knowledge but **suggests new applications**.
- By **application**, we mean **improvement** and **modification**.
- In general, **no new science principles are discovered**, but **existing knowledge is used to develop a new product**.
- A good **example** of this type of **research** is the application of x-rays in medicine

Examples of Applied Research in Technology

- How can **cybersecurity** be improved to prevent **election fraud**?
- Is **current technology use for children helpful** or **harmful**?
- How does **social media** change **individual's perception of society and themselves**?

What is Computer Science Research

- A human activity based on the intellectual investigation of aspects of the world related to the discipline of **Computer Science** for the purpose of **discovering new knowledge**, **interpreting existing knowledge** or **revising erroneous or incomplete knowledge**.

What is Computer Science?

- The systematic **study of computing systems** and **computation**.
- The **body of knowledge** resulting from this discipline contains **theories** for understanding:
  - Computing systems and methods;
  - Design methodology,
  - Algorithms, and tools;
  - Methods for the testing of concepts;
  - Methods of analysis and verification; and
  - Knowledge representation and implementation.

4. Motivation in research

- What makes people to undertake research is a **question of fundamental importance.**
- The **possible motives** for doing research may be:
  - **Desire to get a research degree** with its consequential benefits;
  - **Desire to face challenge in solving unsolved problems**;
  - **Desire to get intellectual joy of doing more creative work**;
  - **Desire to be of service to society**; and
  - Desire to get **respectability** (Kothari, 1990)

4. Motivation in research

- 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 people to perform research operation

4. Motivation in research

- In this '**Age of Information**'
  - How to **find** the information: **searching skills**
  - How to **evaluate it: reviewing skills**
  - How to **report it clearly** and **accurately: writing skills**
  - How to **improve it: Engineering/Scientific Skills**
  - How to **make money out of it: Business skills**

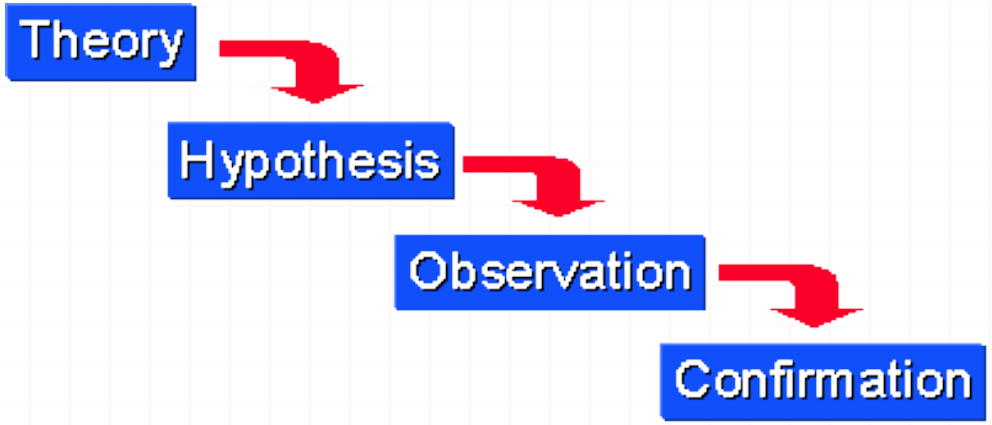
5. General Characteristics of Research

- The following **characteristics** may be gathered from the definitions of "**research**":
  - It gathers **new knowledge or data from primary or first-hand sources**.
  - It places emphasis upon the **discovery of general principles**.
  - It uses certain **valid data gathering devices/tools/methods**.
  - It is **logical** and **exact**.
  - The **researcher eliminates personal feelings and preferences**.
  - Research is **patient** and **unhurried activity:** Conclusions and generalizations are arrived at carefully and cautiously
  - Research is **carefully recorded and reported**.

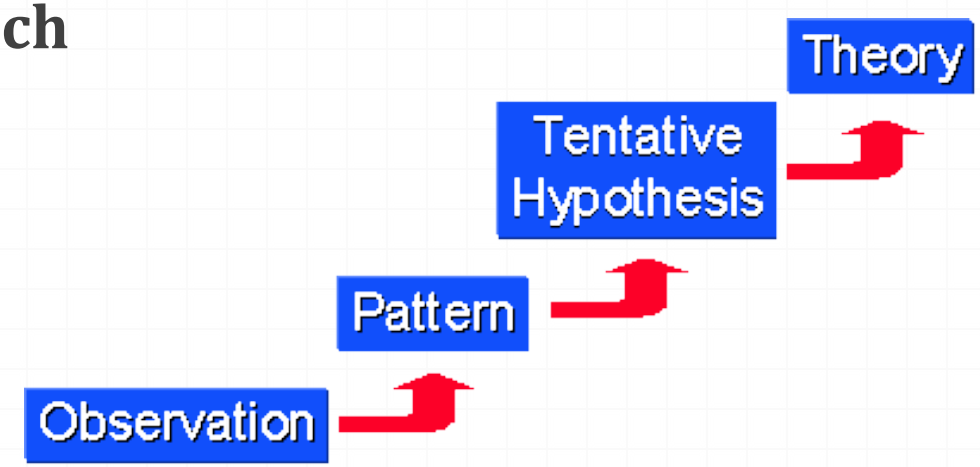
6. Criteria of a Good Research

- Whatever may be research is, one can state the **qualities of good research** as follows:
  - Good research is **systematic**: It means that research is **structured with specified steps** to be taken in **specified sequence** in accordance with the **well-defined set of rules**.
  - Good research is **logical**: This implies that research is **guided by the rules of logical reasoning.** Research uses one of the broad methods of reasoning:
    - **Deductive Approach**: works **from the more general to the more specific**, also called a "**top-down**" approach

6. Criteria of a Good Research



- **Inductive Approach**: works the other way, **moving from specific observations to broader generalizations and theories.** Also called a **"bottom up" approach**



6. Criteria of a Good Research

- Good research is **replicable**: This characteristic allows research results to be **verified** by **replicating the study** and thereby building a sound basis for decisions

Reminder of Definition of Research

- **Research** has **many discrete characteristics** which include the following:
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The Research Question

- A **question that guides your research**
- Characteristics
  - State the **main concepts**
  - Is **neutral=impersonal** (debatable)
  - **Clear** and **specific**
- The question should:
  - **Define** the research
  - **Guide** your inquiries= examinations
  - **Frame** your arguments
  - Be likely to produce your "**contributions**"

Thinking about the question

- **What is the problem** you are attempting to address?
- What is the **unsolved problem that your research will attempt to resolve**?
  - What?
  - Why?
  - Where?
  - When?
  - Who?
  - How?

Is the Question Reasonable?

- What is the **context** of the question?
- Is the question **significant**?
- **What is everyone else doing**?
- Is there **a point of attack on the problem**?
- **Do I like the question**?
  - Am I **curious about it enough** to pursue it?
- Can it be done in **the length of time** I am willing to spend on it?

Example Proto-Questions

- Is there an algorithm that can solve X?
  - Can something be done at all?
- How can this X be improved…?
  - Can something be made better?
- Why does X work?
  - Why does this give the right answer?
- What is the explanation for the phenomenon demonstrated by X?
  - What are the theoretical underpinnings of this
- Can we apply the technique of Y to X to get Z?
  - Can we combine a number of things together and get something new?

State a goal

- This is a description of the **research objectives**!
- Describes the "**nature**" of the answer to your research question
- **Does not actually answer the question.**
- This statement **will let you know when you are done.**

Form a plan

- A **research plan** normally contains
  - Review of how others have addressed it.
    - Sometimes called a **literature review**.
  - Reasoning as to **why the question is significant**.
  - The **methods** you intend to apply to the problem.
    - Called the "**approach**"
  - The **resources** you will need.
  - The **Timetable** you intend to follow.
  - The **Milestones=stages** you will reach.

Formulate experiments and hypotheses

- **Experiment**
  - Set of **actions** to be performed and **observations** made
- **Hypothesis**
  - A statement as to **what you think will happen in the experiment**
  - The **lucky/informed/brilliant/horrible** guess

Activities to Follow

- What are your **assumptions**
- **Collect**, **record** and **interpret data**
  - What data do I need?
  - What does it mean?
- Avoid the temptation to "**avoid interpretation**"
- Remember
  - **Research doesn't happen in straight lines**
  - The **chances of you being right are small** for any given **experiment/hypothesis pair**.

The Thesis Statement

- States **your position on a research question** once you're working on the question
- This is what you "**defend**" in your defense
- Characteristics
  - **Reference the research question**,
  - **Unambiguous indication of your view**
- "**your view**" is developed from doing the research to answer the research question.

Contributions

- Your research **should produce something new**
  - These are your **contributions**
- Your contributions **flow from the answers to your research question** and are (often) **encapsulated in your thesis statement**
- **Contributions** are put in the context of **existing scientific literature** (current practice)

Exercise

- **In 1 paragraph write a good research question concerning a Computer Science topic you are interested in.**
- **In another paragraph, explain what the contributions of answering your questions might be.**