

# Research Process

PhD Course Work -2014

Research Methodology

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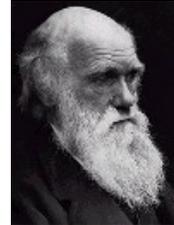
IET-DAVV, Indore



**Researcher's work in graphic form**

Science is composed of aggregated facts from which one can create general laws and conclusions

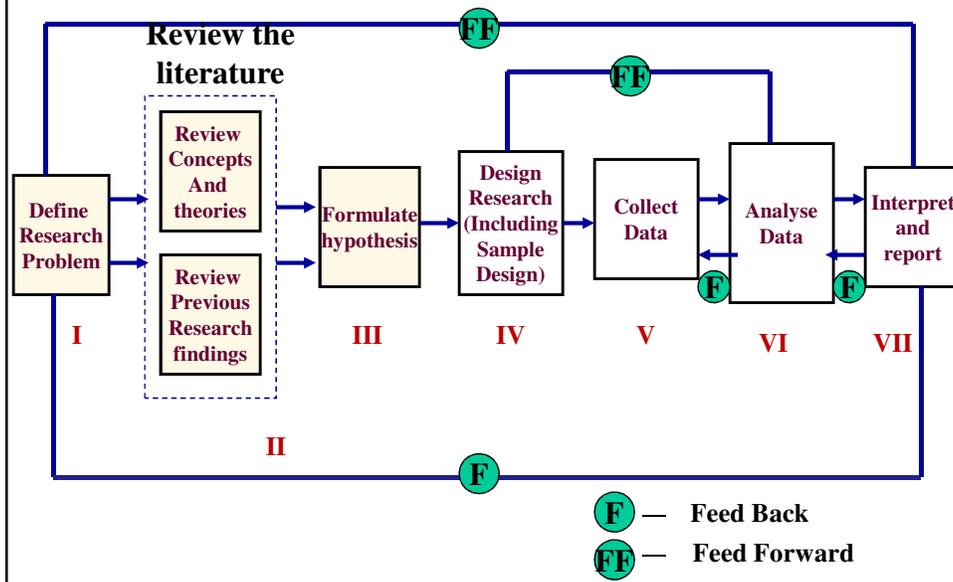
Charles Darwin



**Characteristic features of research are:**

- ❑ Systematic solving of scientific problems using scientific methods
- ❑ system of interconnecting phases and steps

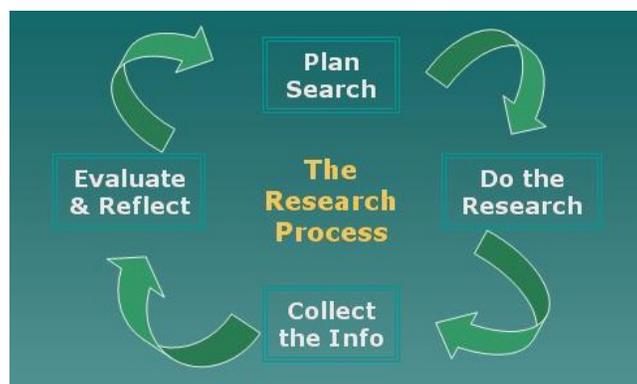
**RESEARCH PROCESS**



### Phases of research process

- I. Phase of conception
- II. Phase of elaboration of research plan
- III. Empiric phase (guided by practical experience)
- IV. Analytic phase
- V. Disseminative phase

### Phases of research process



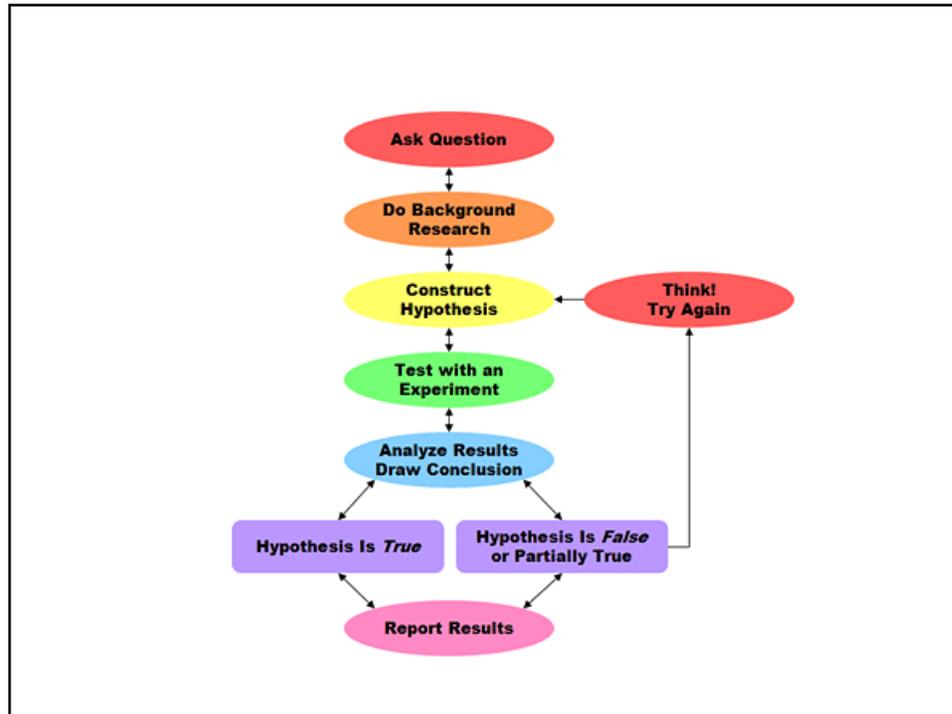
The research process should be understood as one of ongoing planning, searching, discovery, reflection, synthesis, revision, and learning, as shown in the figure

- Phases of research process are most frequently used in the presented order
- But in other guidelines you can find another order of phases and steps. This variability can be ascribed to flexibility of the formal rules of research process which should be adapted to a studied subject and to the special conditions under which the research is done

### **I. Phase of conception**

- 1<sup>st</sup> phase of research process
- phase in which **content and structure** of research are created
- Conceptualisation refers to the process of developing refining abstract ideas. The activities include thinking, rethinking, theorising, making decision, and reviewing ideas.
- It is composed of 4 steps:
  - 1) Formulation and set bounds of research problem, determine the purpose of study
  - 2) Searching and review the literature related to the research problem
  - 3) Development of theoretical construction of the future research
  - 4) Creation of hypothesis

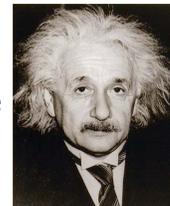




### 1st step: Formulation and set framework of research problem

#### A. Einstein:

If I have one hour for solving the problem on which my life is dependent, than I will devote 40 minutes to study the problem, 15 minutes to analyse it, and only 5 minutes to solve it



#### • Who is able to formulate scientific problem?

- a person with large and high quality of knowledge
- a creative person able to think, with good memory with large and deep cultural knowledge and with ability to persist in research work despite of serious problems



- persons with non-conventional thinking
- person able to doubt on recently valid theories/informations
- person with appropriate dose of curiosity
- person able to resist to fashionable hypotheses and theories
- person possessing excellent memory and appropriate dose of emotionality

### How the research problem is formulated

- accidental observation of phenomenon which we are not able to explain → **curiosity**
- formulation of questions ( why and how the phenomenon originated) →
  - a lot of uncertainties
  - small amount of certainties
- considerations on possible cause(es) of the phenomenon:
  - **discussion with co-workers**
  - **study of literature**
  - **personal experience of researcher**
 → Refinement of research problem
- formulation of first draft of research problem
- considerations whether the research problem is solvable:
  - if yes – than **what kind of methods should be used**
  - if no – it is necessary to go back and start to think by another way



## **2nd step: Looking for informations related to research problem in literature**

The aim of this step:

- to find the „older“ and current informations related to the research problem

We would like to find the answers to following questions:

- did anybody formulate the same research problem as it is ours in the past?
- did anybody solve the same or similar problem as it is ours?
- is the solving of the defined research problem fruitful or not?

**Result of this process is more precisely defined research problem or the research problem is rejected**

## **3) Development of the theoretical construction for solving the research problem**

Main aims: Thinking – on the content of future research  
 – on its timing and structure  
 – on the necessary conditions

Good virtual model of future research will save time, money and decreases probability of stress and mistakes during research

Necessary conditions:

- the research problem is clearly defined
- the technical and personal conditions are available
- the social, legal and ethical views are known
- the main aims are defined

Result of this step: - clear framework for solving the research problem

#### 4) Formulation of hypothesis

- an idea or theory that is not proven but that leads to further study or discussion (Merriam-Webster)

A well-thought-out and focused research question leads directly into hypothesis

- Creation of rational assumption on the possible cause(es) of the observed phenomenon
- Creation of the questions focused to the essence of the research problem



Characteristics of good hypothesis:

- gives insight into research questions
- is testable and measured by the proposed research
- springs logically from the experience of the staff

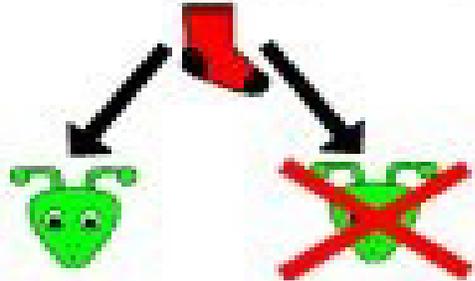
**The goal of science is to find an explanation for why the facts are as they are. Such an explanation is a hypothesis**

A good hypothesis meets several standards. It should provide an adequate explanation of the observed facts. If two or more hypotheses meet this standard, the simpler one is preferred. It should be able to predict new facts

One of the most exciting events in science is to predict the results of an experiment not yet performed if the hypothesis is valid and then to perform the experiment

The null hypothesis ( $H_0$ ) is a hypothesis which the researcher tries to disprove, reject or nullify.

## Where have all my socks gone?



### Alternate Hypothesis

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Extra –terrestrial beings have transported themselves into my house in order to steal my socks.

### Null Hypothesis

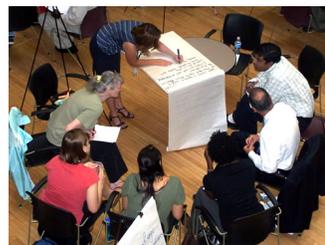
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Aliens are not to blame. There is some other explanation for the disappearing socks.

## II. Phase of elaboration of proposal and research plan

### It is a general plan of research:

- selection of various objects used for solving the problem: - creation of representative sample, inclusion, exclusion criteria
- selection of the methods –qualitative, quantitative
- creation of pilot study
- selection of methods
- selection of research technology
- development a protocol of research
- to define the schedule of research



- to define the control methods: to control if the research procedures are correct or not
- to define the statistical methods used for evaluation of the obtained results
- to define the financial, material and personal needs to secure success in the research

### **III. Empiric phase**

The aim of this phase is production of results, collection of data, and their preparation for next analysis

The results are produced by:

- experiment
- by using questionnaire, interview, observation
- by using models - biological, electronic, mathematic....

**Reproducibility of scientific work**

The single feature that is most characteristic of science is its **reproducibility**. If scientists cannot duplicate their first results, they are forced to conclude that these were **invalid**. This problem occurs often. Its cause is usually some unrecognized, and hence uncontrolled, factor in the experiment (e.g., unrecognized variation in the properties of different batches of the materials used in the experiment).

With luck, the inability to reproduce experiments will be discovered by the same scientists who did the first experiments. This is why scientists generally repeat their experiments several times before reporting them in a scientific paper.

**IV. Analytic phase**

The content of this phase is:

- Quantitative analysis of the data
- Qualitative analysis of the data
- statistic analysis of the data
- interpretation of the results

**Methods used in analytic phase:**

- correlation: looking for relationships among the two or more values
- comparison: comparison of the result obtained in our research with similar research done by other researchers

## V. Disseminative phase

It is the phase when results of the research are published as:

- research report
- lectures and posters at the congresses and conferences
- papers in journals .....

## What do people look for in a scientific contribution?

**Your paper must have:**

**Novelty**- Analysis of prior work to show that your idea is unique

**Placement**- Analysis to show that your work is required, how our work advances the state of the art

**Soundness of procedure** - Steps to show that you have implemented solution carefully

**Evidence to support claim** - Data to show that your solution works as claimed

**Overall coherence** - Consistency between parts of your paper - treatment should address problem, results should give answer to problem

