

# WEEK 1

## RESEARCH METHODOLOGY

### WHAT IS RESEARCH?

Research is a logical and systematic search for new and useful information on a particular topic. In the well-known nursery rhyme:

Twinkle Twinkle Little Star

**How** I Wonder **What** You Are

The use of the words **how** and **what** essentially summarizes what research:

1. It is an investigation of finding solutions to scientific and social problems through objective and systematic analysis.
2. It is a search for knowledge, that is, a discovery of hidden truths. Here knowledge means information about matters. The information might be collected from different sources like experience, human beings, books, journals, nature, etc.

A research can lead to new contributions to the existing knowledge. Only through research is it possible to make progress in a field. Research is indeed civilization and determines the economic, social and political development of a nation.

The results of scientific research very often force a change in the philosophical view of problems which extend far beyond the restricted domain of science itself.

There are vast areas of research disciplines such as:

1. Science and technology.
2. Languages.
3. Literature.
4. History.
5. Sociology.

Whatever might be the subject, research has to be an active, diligent and systematic process of inquiry in order to discover, interpret or revise facts, events, behaviors and theories.

Applying the outcome of research for the refinement of knowledge in other subjects, or in enhancing the quality of human life also becomes a kind of research and development.

### HOW RESEARCH IS DONE?

Research is done with the help of:

1. Study.
2. Experiment.
3. Observation.
4. Analysis.
5. Comparison and reasoning.

Research is in fact ubiquitous. For example:

- we know that cigarette smoking is injurious to health;
- heroine is addictive;
- cow dung is a useful source of biogas;
- malaria is due to the virus protozoan plasmodium;
- AIDS (Acquired Immuno Deficiency Syndrome) is due to the virus HIV (Human Immuno Deficiency Virus).

### **How did we know all these?**

We became aware of all these information only through research. More precisely, it seeks predictions of events, explanations, relationships and theories for them.

## **WHAT ARE THE OBJECTIVES OF RESEARCH?**

The prime objectives of research are:

1. To discover new facts.
2. To verify and test important facts.
3. To analyze an event or process or phenomenon to identify the cause and effect relationship.
4. To develop new scientific tools, concepts and theories.
5. To solve and understand scientific and nonscientific problems.
6. To find solutions to scientific, nonscientific and social problems.
7. To overcome or solve the problems occurring in our everyday life.

## **WHAT MAKES PEOPLE DO RESEARCH?**

This is a fundamentally important question. No person would like to do research unless there are some motivating factors. Some of the motivations are the following:

1. To get a research degree (Doctor of Philosophy (Ph.D.)) along with its benefits like better employment, promotion, increment in salary, etc.

2. To get a research degree and then to get a teaching position in a college or university or become a scientist in a research institution
3. To get a research position in countries like U.S.A., Canada, Germany, England, Japan, Australia, etc. and settle there
4. To solve the unsolved and challenging problems
5. To get joy of doing some creative work
6. To acquire respectability
7. To get recognition
8. Curiosity to find out the unknown facts of an event
9. Curiosity to find new things
10. To serve the society by solving social problems.

Some students undertake research without any aim possibly because of not being able to think of anything else to do. Such students can also become good researchers by motivating themselves toward a respectable goal. Even if you work in a company or run a company, a mind inclined towards research would do better than a mind not trained for it and it was like the story of the hare and the tortoise. If you have a mind trained for research, you will be the tortoise – the climb would be slow and steady, but eventually you would win the race.

## **TYPES OF RESEARCH:**

### **A. Basic Research**

Basic research is an investigation on basic principles and reasons for occurrence of a particular event or process or phenomenon. It is also called theoretical research. Study or investigation of some natural phenomenon or relating to pure science is termed as basic research. Basic researches sometimes may not lead to immediate use or application. It is not concerned with solving any practical problems of immediate interest. But it is original or basic in character. It provides a systematic and deep insight into a problem and facilitates extraction of scientific and logical explanation and conclusion on it. It helps build new frontiers of knowledge. The outcomes of basic research form the basis for many applied research. Researchers working on applied research have to make use of the outcomes of basic research and explore the utility of them.

Research on improving a theory or a method is also referred as fundamental research. For example, suppose a theory is applicable to a system provided the system satisfies certain specific conditions. Modifying the theory to apply it to a general situation is a basic research.

Attempts to find answers to the following questions actually form basic research.

- Why are materials like that?
- What are they?
- How does a crystal melt?
- Why is sound produced when water is heated?
- Why do we feel difficult when walking on seashore?
- Why are birds arrange them in ‘>’ shape when flying in a group?

Fundamental research leads to a new theory or a new property of matter or even the existence of a new matter, the knowledge of which has not been known or reported earlier. For example, fundamental research on:

- (1) Astronomy may leads to identification of new planets or stars in our galaxy,
- (2) Elementary particles results in identification of new particles,
- (3) Complex functions may leads to new patterns or new properties associated with them,
- (4) Differential equations results in new types of solutions or new properties of solutions not known so far,
- (5) Chemical reactions leads to development of new compounds, new properties of chemicals, mechanism of chemicals reactions, etc.,
- (6) Medicinal chemistry leads to an understanding of physiological action of various chemicals and drugs,
- (7) Structure, contents and functioning of various parts of human body helps us identify the basis for certain diseases.

## **B. Applied Research**

In an applied research one solves certain problems employing well known and accepted theories and principles. Most of the experimental research, case studies and inter-disciplinary research are essentially applied research. Applied research is helpful for basic research. A research, the outcome of which has immediate application is also termed as applied research. Such a research is of practical use to current activity. For example, research on social problems has immediate use. Applied research is concerned with actual life research such as research on increasing efficiency of a machine, increasing gain factor of production of a material, pollution control, preparing vaccination for a disease, etc. Obviously, they have immediate potential applications.

Some of the differences between basic and applied research are summarized in table I.

Thus, the central aim of applied research is to find a solution for a practical problem which warrants solution for immediate use, whereas basic research is directed towards finding information that has broad base of applications and thus add new information to the already existing scientific knowledge.

TABLE I: Differences between basic and applied researches.

<b>Basic research</b>	<b>Applied research</b>
Seeks generalization	Studies individual or specific cases without the objective to generalize
Aims at basic processes	Aims at any variable which makes the desired difference
Attempts to explain why things happen	Tries to say how things can be changed
Tries to get all the facts	Tries to correct the facts which are problematic
Reports in technical language of the topic	Reports in common language

### **c. Quantitative and Qualitative Methods**

The basic and applied researches can be quantitative or qualitative or even both.

**Quantitative** research is based on the measurement of quantity or amount. Here a process is expressed or described in terms of one or more quantities. The result of this research is essentially a number or a set of numbers. Some of the characteristics of qualitative research/method are:

- It is numerical, non-descriptive, applies statistics or mathematics and uses numbers.
- It is an iterative process whereby evidence is evaluated.
- The results are often presented in tables and graphs.
- It is conclusive.
- It investigates the what, where and when of decision making.

Statistics is the most widely used branch of mathematics in quantitative research. It finds applications not only in physical sciences but also in economics, social sciences and biology.

Quantitative research using statistical methods often begins with the collection of data based on a theory or hypothesis or experiment followed by the application of descriptive or inferential statistical methods.

**Qualitative** research is concerned with qualitative phenomenon involving quality. Some of the characteristics of qualitative research/method are:

- It is non-numerical, descriptive, applies reasoning and uses words.
- Its aim is to get the meaning, feeling and describe the situation.
- Qualitative data cannot be graphed.
- It is exploratory.
- It investigates the why and how of decision making.

The detection of a particular compound is a qualitative analysis. This can be done by carrying out physical or chemical tests. Determination of exact amount of a particular compound present in a volume is essentially quantitative analysis. This can be done by volumetric, gravimetric and colorimetric methods or instrumental methods. Experimental and simulation studies are generally quantitative research. In fact, qualitative methods can be used to understand the meaning of the numbers obtained by quantitative methods.