Research Methodology: For Beginners

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Abstract:  
In this paper various components of research are briefly discussed. The topics cover a part of the research methodology paper of Doctor of Philosophy (Ph.D.) course. The manuscript is intended for students and research scholars. Various stages of research are discussed in detail and restricted up to various stages of research. Special care has been taken to motivate the young researchers to take up challenging problems.

I. WHAT IS RESEARCH?
Research is a logical and systematic search for new and useful information on a particular topic. It is an investigation of finding solutions to scientific and social problems through objective and systematic analysis. 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 [1].

Research is not confined to science and technology only. There are vast areas of research in other disciplines such as languages, literature, history and 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, behaviours 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 [2, 3, and 4].

Research is done with the help of study, experiment, observation, analysis, comparison and reasoning [5]. Research is in fact everywhere. For example, we know that cow dung is a useful source of biogas, AIDS (Acquired Immune Deficiency Syndrome) is due to the virus HIV (Human Immune 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 [6].

A. 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 analyse an event or process or phenomenon to identify the cause and effect relationship.  
(4) To develop new scientific tools, concepts and theories to solve and understand scientific and non-scientific problems  
(5) To find solutions to scientific, non-scientific and social problems and  
(6) To overcome or solve the problems occurring in our everyday life.  
(7) To develop new scientific tools, concepts and theories to solve and understand scientific and non-scientific problems  
(8) To find solutions to scientific, non-scientific and social problems and  
(9) To overcome or solve the problems occurring in our everyday life [7].
B. What Makes People do Research?

This is a fundamentally important question. No person would like to do research unless there are some motivating factors and those 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[8].

C. Importance of Research

Research is important both in scientific and non-scientific fields. In our life new problems, events, phenomena and processes occur every day. Practically, implementable solutions and suggestions are required for tackling new problems that arise. Scientists have to undertake research on them and find their causes, solutions, explanations, and applications. Precisely, research assists us to understand nature and natural phenomena.

Some important avenues of research are:

1. A research problem refers to a difficulty which a researcher or a scientific community or an industry or a government organization or a society experiences. It may be a theoretical or a practical situation. It calls for a thorough understanding and possible solution.
2. Research on existing theories and concepts help us identify the range and applications of them.
3. It is the fountain of knowledge and provides guidelines for solving problems.
4. Research provides basis for many government policies. For example, research on the needs and desires of the people and on the availability of revenues to meet the needs helps a government to prepare a budget.
5. It is important in industry and business for higher gain and productivity and to improve the quality of products.
6. Mathematical and logical research on business and industry optimizes the problems in them.
7. It leads to the identification and characterization of new materials, new living things, new stars, etc.
8. Only through research inventions can be made; for example, new and novel phenomena and processes such as superconductivity and cloning have been discovered only through research.
9. Social research helps find answers to social problems. They explain social phenomena and seek solution to social problems.
10. Research leads to a new style of life and makes it delightful and glorious.

II. RESEARCH METHODS AND RESEARCH METHODOLOGY
Is there any difference between research methods and research methodology?

Research methods are the various procedures, schemes and algorithms used in research. All the methods used by a researcher during a research study are termed as research methods. They are essentially planned, scientific and value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc. Research methods help us collect samples, data and find a solution to a problem. Particularly, scientific research methods call for explanations based on collected facts, measurements and observations and not on reasoning alone. They accept only those explanations which can be verified by experiments.

Research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research [9,10].

A. Importance of Research Methodology in Research Study

It is necessary for a researcher to design a methodology for the problem chosen. One should note that even if the method considered in two problems is same the methodology may be different. It is important for the researcher to know not only the research methods necessary for the research under taken but also the methodology. For example, a researcher not only needs to know how to calculate mean, variance and distribution function for a set of data, how to find a solution of a physical system described by mathematical model, how to determine the roots of algebraic equations and how to apply a particular method but also need to know (i) Which is a suitable method for the chosen problem?, (ii) What is the order of accuracy of the result of a method?, (iii) What is the efficiency of the method? More precisely, research methods help us get a solution to a problem. On the other hand, research methodology is concerned with the explanation of the following: (1) Why is a particular research study undertaken? (2) How did one formulate a research problem? (3) What types of data were collected? (4) What particular method has been used? (5) Why was a particular technique of analysis of data used?

The study of research methods gives training to apply them to a problem. The study of research methodology provides us the necessary training in choosing methods, materials, scientific tools and training in techniques relevant for the problem chosen.

III. TYPES OF RESEARCH

Research is broadly classified into two main classes:

A. Fundamental or basic research
B. Applied research
C. Normal and Revolutionary Researches
D. Quantitative and Qualitative Methods
E. Other 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 difficulty 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 [8].

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.

C. Normal and Revolutionary Researches

Basic and applied researches are generally of two kinds: normal research and revolutionary research. In any particular field, normal research is performed in accordance with a set of rules, concepts and procedures called a paradigm, which is well
accepted by the scientists working in that field. Normal research is something like puzzle-solving: interesting, even beautiful, solutions are found but the rules are remains same. In this normal research some-times unexpected novel results and discoveries are realized which are inconsistent with the existing paradigm. Among the scientist, a tense situation then ensues, which increases in intensity until a scientific revolution is reached. This is marked by a paradigm shift and a new paradigm emerges under which normal scientific activity can be resumed [11].

D. 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 [10]:

- 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

[12]. 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.

E. Other Types of Research

Other types of research include action research, explanatory research and comparative research.

IV. VARIOUS STAGES OF A RESEARCH

Whenever a scientific problem is to be solved there are several important steps to follow. The problem must be stated clearly, including any simplifying assumptions. Then develop a mathematical statement of the problem. This process may involve use of one or more mathematical procedures. Frequently, more advanced text books or review articles will be needed to learn about the techniques and procedures. Next, the results have to be interpreted to arrive at a decision. This will require experience and an understanding of the situation in which the problem is embedded. A general set of sequential components of research is the following:

1. Selection of a research topic
2. Definition of a research problem
3. Literature survey and reference collection
4. Assessment of current status of the topic chosen
5. Formulation of hypotheses
6. Research design
7. Actual investigation
8. Data analysis
9. Interpretation of result
10. Report
REFERENCES: