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Basics of Academic Project Preparation

Unit 1

Q: What do you understand by Research? (www.prepNext.com)

Ans:

The word *research* is derived from the Middle French "*recherche*", which means "to go about seeking". Generally speaking Research refers to a search for knowledge. It is a scientific and systematic search for pertinent information on specific topic or phenomenon. It is a movement from the known to the unknown.

According to **Advanced Learner's Dictionary of Current English** research is "a careful investigation or inquiry specially through search for new facts in any branch of knowledge".

According to Redman and Mory Research is a "systematized effort to gain new knowledge".

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Research is the process of systematic and in-depth study or search for any particular topic, subject or areas of investigation, which is backed by

- Collection,
- Compilation,
- Presentation, and
- Interpretation of relevant details or data.

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. A few general objectives of research are:

- (i) To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies);
- (ii) To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies);
- (iii) To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies);
- (iv) To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

Q: Describe the different types of research. (www.prepNext.com)

Ans:

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There are different types of research depending on their nature. The basic types of research are:

1) DESCRIPTIVE VS. ANALYTICAL:

Descriptive research is basically a fact-finding enquiry of different kind. It is a type of research which describes the state of affairs as it exists at present. In social science and business research we quite often use the term *Ex-post facto research* for descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening. In most of the descriptive research studies the researcher seeks to measure such items as , for example, frequency of shopping, preferences of people, accounting practices of grocers, or similar data. The methods of research utilized in descriptive research are survey methods of all kinds.

In **analytical research**, on the other hand, the researcher has to use facts or information that are already available, and analyze these to make a critical evaluation of the material.

2) APPLIED VS. FUNDAMENTAL:

Applied research is also called action research. It aims at finding a solution for an immediate problem facing a society or an industry/ business organisation. Research aimed at certain conclusions facing a concrete social or business problem is an example of applied research. Research to identify social, economic or political trends that may affect a particular institution, marketing research, evaluation research are examples of applied research. The central aim of applied research is to discover a solution for some pressing practical problems.

Fundamental or pure or basic research is mainly concerned with with generalisations and with the formulation of a theory. Gathering knowledge for knowledge's sake is termed fundamental research.

Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research. Similarly, research studies concerning human behaviour carried on with a view to make generalisations about human behaviour are also examples of fundamental research. Fundamental research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organised body of scientific knowledge.

3) QUANTITATIVE VS. QUALITATIVE:

Quantitative research is based on the quantitative measurements of some characteristics. It is applicable to phenomena that can be expressed in terms of quantity. It is based on the measurement of quantity or amount. It is purely data based and is quite popular.

Qualitative research is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. It based on the subjective assessment of attributes, motives, opinion, desires etc. For instance, when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things), we use 'Motivation Research', an important type of qualitative research. This type of research aims at discovering the underlying motives and desires, using in-depth interviews for the purpose. Other techniques of such research are word association tests, sentence completion tests, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also, qualitative research. Qualitative research is specially important in the behavioural sciences where the aim is to discover the underlying motives of human behaviour. Through such research we can analyse the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing.

4) CONCEPTUAL AND EMPIRICAL:

Conceptual research is related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to interpret existing ones.

Empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. It can be called experimental type of research. In such a research, it is necessary to get facts at firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information. In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. Such research is characterised by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way.

5) ONE TIME RESEARCH VS. LONGITUDINAL RESEARCH:

From the view point of time, research can be one time research or longitudinal research. The research which is confined to a single time-period is known as **one time research**. Most of the sample studies or diagnostic studies are of this type.

The research which is carried on over several time periods is called **longitudinal research**. Industrial development during the five year plan is an example of this type.

6) EXPLORATORY VS. FORMALIZED:

The research may be exploratory or it may be formalized. The objective of **exploratory research** is the development of hypotheses rather than their testing, whereas **formalized research** studies are

those with substantial structure and with specific hypotheses to be tested.

7) CONCLUSION-ORIENTED VS. DECISION-ORIENTED:

While doing **conclusion-oriented research**, a researcher is free to pick up a problem, redesign the enquiry as he proceeds and is prepared to conceptualize as he wishes.

Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Operations research is an example of decision oriented research since it is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

8) SOME OTHER TYPES OF RESEARCH:

Research can be **field-setting research** or **laboratory research** or **simulation research**, depending upon the environment in which it is to be carried out.

Research can as well be understood as **clinical** or **diagnostic research**. Such research follow case-study methods or indepth approaches to reach the basic causal relations. Such studies usually go deep into the causes of things or events that interest us, using very small samples and very deep probing data gathering devices. **Historical research** is that which utilizes historical sources like documents, remains, etc. to study events or ideas of the past, including the philosophy of persons and groups at any remote point of time.

RESEARCH APPROACHES

There are two basic approaches to research:

- (i) Quantitative approach, and
- (ii) Qualitative approach

(i) The quantitative approach involves the generation of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. This approach can be further sub-classified into:

- (a) Inferential approach
- (b) Experimental approach, and
- (c) Simulation approach to research

(a) The purpose of inferential approach is to form a data base to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.

(b) Experimental approach is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.

(c) Simulation approach involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behaviour of a system (or its sub-system) under controlled conditions.

(ii) Qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which is not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used.

Q: Discuss the utility of research.

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Ans:

Importance/ Utility of Research

The utility of research is immense. It has gained importance, both for government and business.

Utility of Research for Government:

Research provides the basis for nearly all government policies in our economic system. It is used in economic planning for development of a nation. The union finance budget and railway budget are the example in which research is best applied. Government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives. This facilitates the decisions of the policy maker.

The plight of cultivators, the problems of big and small business and industry, working conditions, trade union activities, the problems of distribution, even the nature of defence services, are matters requiring research. Thus, research is considered necessary with regard to the allocation of nation's resources.

Another area in government where research is necessary is collecting information on the economic and social structure of the nation. Such information indicates what is happening in the economy and what changes are taking place.

Utility of Research for Business:

Research has special significance in solving various operational and planning problems of business. It plays a vital role in making sound decisions affecting future operation of the business. The major areas are:

Marketing: In modern times marketing research plays an important role in taking sound marketing decisions. Marketing research generally involves the process of collection, compilation and interpretation of data in order to make demand forecasting, understand buying behaviour of consumer, and find out the potential of new product.

Production: Research helps the business to decide on what to produce, how much to produce and for whom to produce. Research tools also help in quality control and setting up inventory levels.

Human Resource Development: Research also plays an important role in identifying the needs of worker and formulating manpower policies. The Human Resource Development department uses research to study wage rate, incentive scheme, and employment trends for future needs. Further, it also uses research effectively for its most important activity namely manpower planning.

Cost Minimization or Profit Maximisation: Operations research is used to find solution of business problems of cost minimization or of profit maximization or what can be termed as optimization problems.

Determining Consumer Motivation: Motivational research is used to determine motivations underlying the consumer behavior.

Banking: Research also helps in banking institution in various ways. It helps in gathering and analyzing information both for their internal operations and for making in depth studies on the economic conditions of business.

The major benefits of business research are:

- Business research helps to increase the profits of the business
 - Helps in the analysis, evaluation and interpretation of business environment
 - Helps in forecasting
 - Helps in finding out the problem areas
 - Helps in establishing relationship between different business variables of a functional area and also between different functional areas.
 - It provides necessary inputs to Management Information System and Business Intelligence System
 - Helps in the decision-making process
 - Helps in the formulation of business strategies and policies.
 - Gives a basis for innovation
 - Facilitates optimum utilization of scarce resources
-

Q: Discuss the limitations of research in India.

OR

What are the problems faced by researchers in India?

(www.prepNext.com)

Ans:

Some of the main limitations of research are:

1) Lack of Scientific Training: Many researchers lack scientific training and take a leap in the dark without knowing research methods. As a result, the research results, quite often, do not reflect the reality.

2) Change in Validity of Data with Time: All business decisions are concerned with human beings. As a result, validity of the data collected, findings arrived at and recommendations made also change with the change in time.

3) Afraid to accept conclusions: Decision makers in the business normally do not rely on the conclusions and findings of research for taking business decisions. They are afraid to do so, as they think it to be risky.

4) Not Affordable for Small Organizations: Small organizations find it difficult to afford a Research and Development department.

5) Lack of Ethics: Ethical codes of conduct are many times violated while doing research.

6) Limited Access to Information: Many business decision makers have constraints in finance and Information Technology infrastructures. This limit their access to information needed to conduct business research.

7) Dependence on customs and traditions: Most of the decision makers depend on traditions, customs, routines and practices, and less on research.

8) Lack of scientific training: Most of the researchers and the users of research tools and techniques lack scientific training.

9) Lack of Interaction: There is lack of interaction between the university research departments, business firms, governments departments and researcher institutions. As a result, a great deal of primary data of non-confidential nature remains untouched by the researchers.

10) Fear of Loss of Secrecy: Most of the business firms in our country do not have the confidence that the material supplied by them to researchers will not be misused and as such they are often reluctant in supplying the needed information to researchers.

11) Overlapping Studies: Research studies overlapping one another are undertaken quite often for want of adequate information. This results in duplication and waste of resource.

12) Inadequate Secretarial Assistance: Inadequate secretarial assistance, including computerial assistance, available to the

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researchers of our country causes unnecessary delays in the completion of research studies.

13) Unsatisfactory Library Management and Functioning: Library management and functioning in our country is not satisfactory at many places and much of the time and energy of researchers are wasted in tracing out the relevant books, journals, reports, etc. There is also a problem that many of our libraries are not able to get copies of old and new Acts, reports and other government publications in time.

14) Non-Availability of Published Data in Time: There is also the problem of non-availability of published data from various government and other agencies doing this job in our country. Also, the published data vary significantly because of differences in coverage by the concerning agencies.

15) Non-Existence of Code of Conduct: There does not exist a code of conduct for researchers and inter-university and inter-departmental rivalries are also quite common. Hence, there is a need for developing a code of conduct for researchers.

Q: Write short notes on (a) fact, (b) concept, and (c) theory.

(www.prepNext.com)

Ans:

FACTS

A fact is taken as something definite or something which happens or which is correct. According to one view, fact is an abstraction. According to another view fact is an observation which is based upon experience. In other words, fact is a correct observation. According to the Concise Oxford Dictionary, a fact is happening of an incident, a correct statement, a matter of experience, the reality of situation, the conclusion of some observations or actually present phenomenon. Thus, facts are true and they are the real elements of incidents. They are subject to hearing, seeing or experiencing.

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CONCEPT

Concepts are the building blocks of social research. According to McClelland, a concept is a 'shorthand representation of a variety of facts. Its purpose is to simplify think by subsuming a number of events under one general heading'. Thus the concept is an abstraction or generalisation of facts. It is used in sophisticated scientific observation for interpretation of facts. It is, however, not confined to scientific thinking alone. It is very much a part of daily life. Everybody requires the use of concepts for interpretation of experience. The concepts are defined according to theoretical orientation of the researcher. That is why concept can convey several meaning and impressions. A scientific investigation aims at the interpretation of facts through concepts. Different people hold different concepts of the same thing.

Features of Good Concept:

- (i) The concept should be clear and definite or precise.
- (ii) The concept should be comprehensive and clear in formulation and understanding.
- (iii) The concept should avoid multiple meaning and as far as possible a concept should convey exactly what was intended when the concept was coined.

THEORY

A theory is an imagination, hypothesis or proposition According to Talcott Parsons, a theory is a group of closely interrelated concepts used for interpretation of some experience. In the words of Goode and Hatt, 'Theory refers to the relationships between facts or the ordering of them in some meaningful way.' Thus, theories are constituted out of facts.

A theory provides a logical order to a group of facts. Thus theory is a generalised principle. A successful theory depends upon proper verification of propositions/ hypothesis. Theories which do not possess the characteristics of verification are known as imaginary and false.

Theory plays an important role in research. It narrows the ranges of facts to be studied. It provides a conceptual framework for a study.

It summarizes concisely what is already known about the object of study. A theory also states a general uniformity beyond the immediate observations.

Characteristics of Theory:

A sound theory must meet the following criteria :

1. A theory must be stated in simple and precise terms. A theory that explains in a simple manner is preferred to one that has more complexities and assumptions.
 2. A theory must be in conformity both with the observed and with the previously established body of knowledge or validated theory.
 3. A theory must provide means for its own interpretation and verification. In other words, it must provide deductions which can be tested empirically.
 4. A theory must guide new discoveries and identify areas which are in need of investigation.
-

Q: What are the essentials/ criteria of a good research?

(www.prepNext.com)

Ans:

CRITERIA OF GOOD QUALITY RESEARCH

Every research study should satisfy the following criteria:

(a) The purpose of research should be **clearly defined**, using common concepts.

(b) The **research procedure used should be described in sufficient detail** so as to permit other researchers to repeat the research for further advancement, keeping the continuity of what has already been attained.

(c) The **procedural design** of the research should be carefully planned to give objective results.

(d) The researcher should state **with complete frankness**, flaws in the procedural design and estimate their effects upon the findings and conclusions.

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(e) Any limitations and assumptions made by the researcher during the course of study should be clearly **highlighted**.

(f) The analysis of data should be sufficiently adequate to reveal its significance. Methods used for analysis should also be appropriate.

(g) The validity and reliability of the data should be checked regularly and carefully.

(h) Conclusions should be limited to those justified by the data of the research.

(i) The researcher should be experienced and a person of integrity. This will increase the confidence in the research study.

In other words, the qualities of a good research can be stated as under:

1) Good research is systematic: It means that research is structured and well-defined with specified steps to be taken in a specified sequence in accordance with well defined set of rules. This does not rule out creative thinking but does reject the use of guessing and intuition in arriving at conclusions.

2) Good research is logical: This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of great value in carrying out research. This makes a research more meaningful for the purpose of decision making.

3) Good research is empirical: It implies that research is related basically to one or more aspects of a real situation, and is supported by practical experiences and practical examples. It deals with concrete data that provides a basis for external validity to research results.

4) Good research is replicable: Steps that one follow or design to follow in a research should be such that anyone doing the research on the same subject, by following the same process, should arrive at the same conclusions.

Q: Briefly describe the different steps involved in a research process. *(www.prepNext.com)*

Ans:

Research process consists of a series of actions or steps necessary to carry out research effectively.

A diagram showing below depicts the broad steps that a researcher usually takes in the process.



A brief description of the above stated steps is given below:

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1. Defining Research Problem

Defining the research problem is the first step of research process. Essentially, two steps are involved in formulating research problems; that is, understanding the problem thoroughly, and rephrasing it into meaningful terms. Often, a problem is put in general terms and then it is narrowed down and formulated into a specific research problem.

The task of formulating a research problem is an important step in the entire process of research. The problem under study must be defined unambiguously for that will help discriminating relevant data from irrelevant ones. Defining the problems helps in determining the relevant data to be collected as per problem, determining the relations which are to be explored, choice of techniques to be used and the form of the final report.

2. Review of Literature

The researcher should undertake extensive literature survey connected with the problem. Journals, government reports, books, conference proceedings, etc. must be tapped depending on the nature of the problem. The earlier studies, if any, which are similar to the study in hand, should be carefully studied. One can also take help of the internet and use online search engines to search scholarly articles. The purpose of reviewing existing literature is to get some idea about the research study and gain knowledge on the availability of data and materials about the proposed area.

3. Formulation of Hypothesis

After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. Research hypotheses provide the focal point for research. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. Hypothesis not only indicates the type of data required but also the type of method of data analysis to be used. It may, however, be noted that occasionally we may encounter a problem where we do

not need working hypotheses, specially in the case of exploratory or formulative researches which do not aim at testing the hypothesis.

4. Research Design

Research design is the conceptual structure within which research would be conducted. The function of research design is to provide for the collection of relevant evidence with optimum effort, time and expenditure. A suitable design is one that minimises bias and maximises the reliability of the data collected.

The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

- (a) the means of obtaining the information;
- (b) the availability and skills of the researcher and his staff (if any);
- (c) explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection;
- (d) the time available for research; and
- (e) the cost factor relating to research, i.e., the finance available for the purpose.

5. Determining Sample Design

The researcher must decide the way of selecting a sample or what is popularly known as the sample design. A sample design is a definite plan determined before any data is actually collected for obtaining a sample from a given population. Samples can be either probability samples or non-probability samples. Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques. The sample design to be used must be decided by the researcher taking into consideration the nature of the inquiry and other related factors.

6. Collection of data

After working out the methods and techniques of data collection, it becomes necessary to collect data that is appropriate. There are several ways of collecting the appropriate data which differ considerably in context of cost, time and other resources at the disposal of the researcher.

There are broadly two sources of data —primary sources and secondary sources. Primary sources are observations, interviews, questionnaires and schedules. On the other hand, the sources of secondary data are the various publications, journals, books, magazines, newspapers, various reports, diaries, letters, biographies, autobiographies, websites, etc..

The researcher should select one of these methods and sources of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy.

7. Execution of the Project:

Execution of the project is a very important step in the research process. The researcher should see that the project is executed in a systematic manner and on time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine processed. In such a situation, questions as well as the possible answers may be coded. If the data is to be collected through interviewers, arrangements should be made for proper selection and training of the interviewers. Occasional field checks should be made to ensure that the interviewers are doing their assigned job sincerely and efficiently. Steps should be taken to ensure that the survey is under statistical control so that the collected information is in accordance with the pre-defined standard of accuracy.

8. Analysis of Data:

Analysis of data requires a number of closely related operations such as classification, coding, editing and tabulation of raw data. The mechanical devices can be made use of at this juncture. A great deal

of data, specially in large inquiries, is tabulated by computers. Computers not only save time but also make it possible to study large number of variables affecting a problem simultaneously.

Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well defined statistical formulae. Researcher can analyse the collected data with the help of various statistical measures.

9. Hypothesis –testing:

After analysing the data as stated above, the researcher is in a position to test the hypothesis, if any, he had formulated earlier. Various tests, such as Chi square test, t-test, F-test, have been developed by statisticians for the purpose. The hypothesis may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis –testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypothesis to start with, generalisations established on the basis of data may be stated as hypothesis to be tested by subsequent researches in times to come.

10. Generalisations and Interpretation:

The real value of research lies in its ability to arrive at certain generalisations. If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation.

11. Report writing

The last stage of research process is report writing. The report is generally written in such a way that the readers can grasp the context, methodology and findings easily. The layout of the report should be as follows: the preliminary pages; the main text, and the end matter. At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography i.e., list of books, journals, reports, etc., consulted, should also be given at the end.

The various stages of research process explained above for carrying out a research/ project work will no doubt provide a basic ground in preparing or constructing research activity.

Q: Explain: Research encompasses activities that increase the sum of human knowledge

OR

Explain the role of research in important areas.

(www.prepNext.com)

Ans:

Research is the process of systematic and in-depth study or search, which is backed by

- Collection,
- Compilation,
- Interpretation, and
- Presentation of relevant details or data.

Research activities make progress possible. It inculcates scientific and inductive thinking and promotes the development of logical habit of thinking and organization.

The role of research in different fields like applied economics, whether related to business or economy, has greatly increased in modern times.

1) Research provides the basis for nearly all government policies in our economic system. (For instance, government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of needs has to be equated to probable revenues and this is a field where research is most needed.) Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives.

- 2) Research is considered necessary with regard to the allocation of nation's resources.
- 3) Research is necessary in collecting information on the economic and social structure of the nation
- 4) Research has special significance in solving various operational and planning problems of business. Operations research and market research along with motivation research help in taking business decisions.
- 5) Research is also important for social scientists who want to study social relationships and seek answers to different social problems. Research provides intellectual satisfaction of knowing things just for the sake of knowledge, which can be put to practical use.
- 6) For an analyst or an intellectual, research may be the generalization or formulation of new theory.
- 7) To a philosopher or a thinker, research may be the outlet for new ideas and insights.
- 8) To a literary person, research may be the development of new styles and creativity in work.
- 9) To some research professionals, research may be a source of livelihood.
- 10) To students, who are writing thesis for Masters or PH.D, research may be a career or it may be a means to achieve a high position in the society.

Thus, we see that research is a fountain of knowledge and an important source of providing guidelines so as to solve various business, government and social problems. It is a kind of formal training which helps one to understand, in a better way, the new development in one's field.

Q: What is research problem? Explain the issues to be considered while selecting a problem. (www.prepNext.com)

Ans:

RESEARCH PROBLEM

The first and foremost step in research process is selecting and properly defining a research problem. A research problem refers to some difficulty experienced by a research in the context of either a theoretical or practical situation, for which he wants to obtain a solution. An individual or a group of persons can be said to have a problem which can be technically described as a research problem, if they (individual or the group), having one or more desired outcomes, are confronted with two or more courses of action that have some but not equal efficiency for the desired objective(s) and are in doubt about which course of action is best.

The **components of a research problem** are as under:

- (a) There must be an individual or a group having some problem or the difficulty.
- (b) There must be some goal or objective to achieve. It is obvious that if a person wants nothing, he/she cannot have a problem.
- (c) There must be alternative means (or the courses of action) to achieve the objectives. It is to be noted that there must be at least two or more alternative means available to a researcher. If the researcher does not have a choice of means, there is no problem.
- (d) There must be some doubt in the mind of a researcher regarding the selection of alternatives.
- (e) There must be one or more environments to which the difficulty pertains.

Thus, a research problem is one which requires a researcher to find out the best solution for the given problem, i.e., to find out by which

course of action the objective can be attained optimally in the context of a given environment.

POINTS TO BE CONSIDERED WHILE SELECTING A PROBLEM

The research problem undertaken for study must be carefully selected. The following points may be observed by a researcher in selecting a research problem or a subject for research:

1. Researcher's interest: The researcher must have personal interest in the results of the study. In the absence of researcher's personal interest, the research cannot be successful.

2. Topic of significance: Subject to be chosen should be significant and useful. The researcher should see that the topic of the study should be of present day relevance to some practical problem.

3. Novelty of the idea: Subject which is overdone should not be normally chosen, for it will be a difficult task to throw any new light in such a case. The subject or topic of research should be original or at least less explored.

4. Availability of data: The researcher must consider whether the required data for the project are adequately available. If the study is based mainly on secondary data, the researcher has to ensure whether the data is within his access. In case the research is based on primary data the researcher must see whether the respondents will answer the questions.

5. Researcher's resources: The resources of the researcher are his intelligence, qualifications, training, experience, and other facilities such as funds, clerical and technical assistance, library facilities and availability of time. Time is the most important factor in choosing a problem. A topic should be selected in such a way as to complete the study within the given time limit.

6. Non-Controversial Subject: Controversial subject should not become the choice of an average researcher.

7. Familiar and Feasible Subject: The subject selected for research should be familiar and feasible so that the related research material or sources of research are within one's reach.

8. Preliminary Study: The selection of a problem must be preceded by a preliminary study. This may not be necessary when the problem requires the conduct of a research closely similar to one that has already been done. But when the field of inquiry is relatively new and does not have available a set of well developed techniques, a brief feasibility study must always be undertaken.

9. Too narrow or too vague problems should be avoided.

Q: Describe fully the techniques of defining a research problem.

(www.prepNext.com)

Ans:

TECHNIQUE INVOLVED IN DEFINING A PROBLEM

The research problem should be defined in a systematic manner, giving due weightage to all relating points. The technique for the purpose involves the undertaking of the following steps generally one after the other (i) statement of the problem in a general way; (ii) understanding the nature of the problem; (iii) surveying the available literature; (iv) developing the ideas through discussions; and (v) rephrasing the research problem into a working proposition

(i) Statement of the problem in a general way: First of all the problem should be stated in a broad general way, keeping in view either some practical concern or some scientific or intellectual interest. Then the researcher should narrow it down and phrase the problem in operational terms. The problem stated in a broad general way may contain various ambiguities which must be resolved by cool thinking and rethinking over the problem. At the same time the

feasibility of a particular solution has to be considered and the same should be kept in view while stating the problem.

(ii) Understanding the nature of the problem: The next step in defining the problem is to understand its origin and nature clearly. For a better understanding of the nature of the problem involved, the researcher can enter into discussion with those who have a good knowledge of the problem concerned or similar other problems. The researcher should also keep in view the environment within which the problem is to be studied and understood .

(iii) Surveying the available literature: All available literature concerning the problem at hand must necessarily be surveyed and examined before a definition of the research problem is given. This is done to find out what data and other materials, if any, is available for operational purposes. Studies on related problems are useful for indicating the type of difficulties that may be encountered in the present study as also the possible analytical shortcomings. At times such studies may also suggest useful and even new lines of approach to the present problem.

(iv) Developing the ideas through discussions: Discussion concerning a problem often produces useful information. Various new ideas can be developed through such an exercise. Hence, a researcher must discuss his problem with his colleagues and others who have enough experience in the same area or in working on similar problems. People with rich experience are in a position to enlighten the researcher on different aspects of his proposed study and their advice and comments are usually invaluable to the researcher.

(v) Rephrasing the research problem: Finally, the researcher must rephrase the research problem into a working proposition. Through rephrasing, the researcher puts the research problem in as specific terms as possible so that it may become operationally viable and may help in the development of working hypothesis.

In addition to what has been stated above, the following points must also be observed while defining a research problem:

- (a) Technical terms and words or phrases, with special meanings used in the statement of the problem, should be clearly defined.
- (b) Basic assumptions or postulates (if any) relating to the research problem should be clearly stated.
- (c) The criteria for the selection of the problem should be provided.
- (d) The suitability of the time-period and the sources of data available must also be considered by the researcher in defining the problem.
- (e) The scope of the investigation or the limits within which the problem is to be studied must be mentioned explicitly in defining a research problem.

Q: What do you understand by research plan? Discuss the activities contained in a research plan.

Or

How can a research plan be developed? (www.prepNext.com)

Ans:

DEVELOPING A RESEARCH PLAN

A plan is a predetermined course of action. It is deciding in the present, what is to be done in future. It is the process of thinking before doing. Any research activity requires planning. A research plan must describe the proposed research, its significance and way in which it will be conducted.

Research Plan is essential specially for new researcher because of the following:

- (a) It helps him to organize his ideas in a form whereby it will be possible for him to look for flaws and inadequacies, if any.
- (b) It provides an inventory of what must be done and which materials have to be collected as a preliminary step.
- (c) It is a document that can be given to others for comment.

Research plan must contain the following activities:

1. Stating Research Objectives: Research objective should be clearly stated which tells exactly what it is that the researcher expects to do.

2. Stating the Research Problem: The problem to be studied by researcher must be explicitly stated so that one may know what information is to be obtained for solving the problem.

3. Defining major concepts: Each major concept which researcher wants to measure should be defined in operational terms in context of the research project.

4. Description of the Method: The plan should contain the method to be used in solving the problem. An overall description of the approach to be adopted is usually given and assumptions, if any, of the concerning method to be used are clearly mentioned in the research plan.

5. Description of the techniques: The plan must also state the details of the techniques to be adopted. For instance, if interview method is to be used, an account of the nature of the contemplated interview procedure should be given. Similarly, if tests are to be given, the conditions under which they are to be administered should be specified along with the nature of instruments to be used. If public records are to be consulted as sources of data, the fact

should be recorded in the research plan. Procedure for quantifying data should also be written out in all details.

6. Specifying the Population and the Sample: A clear mention of the population to be studied should be made. If the study happens to be sample based, the research plan should state the sampling plan i.e., how the sample is to be identified.

7. Methods for Processing Data: The plan must also contain the methods to be used in processing the data. Statistical and other methods to be used must be indicated in the plan.

8. Developing a Time Line for the Project: Every research project is conducted to gather information for specific purpose. That purpose is most likely time sensitive. There is an implied deadline when the information must be available. An important part of the planning phase is identifying the important project milestones to help ensure that the information is available from the survey when it is needed.

9. Pilot Test Report: Results of pilot test, if any, should be reported.

10. Preparation of Cost Budgets: Time and cost budgets for the research project should also be prepared and laid down in the plan itself.

FORMULATION OF RESEARCH QUESTIONS

Research questions are the questions that the researcher would like to be answered or addressed. Basically, research questions are specific in nature in comparisons to general presentation of ideas. Research questions are generally framed at the beginning of research problem following the review of literature. A researcher at the start begins with a broad formulation of a problem. From this he has to move to a specific problem. The purpose of research is narrowed down in the form of research question statement.

Formulation of research problem is not always easy for the researcher. For this the researcher has to gather knowledge from the existing literature and past works. Moreover, an important point regarding the final statement of research problem is that it must be specific, precise, feasible and reasonable.

Characteristics of Good Research Questions:

Good research questions must possess the following characteristics:

- (i) Research questions must be researchable.
- (ii) Research questions should be based on strong theoretical basis.
- (iii) The research question should not be stated in so general terms as to become vague.
- (iv) A good research question must explain the relationship among variables.
- (v) A good research question must serve as a guide for planning the study and selection of suitable statistical technique.
- (vi) The solution of good research question must have certain value to interested groups.
- (vii) The solution of research question should be within the time frame, and possible with the available financial resources.
- (viii) The data needed for the solution of research question should be accessible.

Q: What is research design? Why is it necessary for conducting a study? (www.prepNext.com)

Ans:

Meaning of Research Design:

After defining the research problem the most important step of research work is to prepare the research design. Research design is also known by various names such as research outline, research plan and research blue print. Research designs are the plans that specify how data should be collected and analyzed for the purpose of research. Basically, a research design is the conceptual structure of research; it constitutes the blueprint for the collection, measurement and analysis of data.

According to William Zikmund research design is “a master plan specifying the methods and procedures for collecting and analysing the needed information.”

According to Pauline V. Young “A research design is logical and systematic planning and directing a piece of research.”

A good research design involves answering the following questions:

- (i) What is the study about?
- (ii) Why is the study being done?
- (iii) Where will the study be carried out?
- (iv) What type of data is required for the study?
- (v) Where can the required data be found?
- (vi) How much time will the study require?
- (vii) What will be the sample design for the study?
- (viii) What techniques of data collection will be used?
- (ix) How will the data be analysed?
- (x) To what target audience its reporting is meant?
- (xi) In what style will the report be prepared?

NEED FOR RESEARCH DESIGN:

Research design helps in the smooth operations of the various steps involved in a research process. Research design is utmost necessary in any research work because of the following factors:

- a) It provides maximum information with minimum expenditure of time, energy and money.
- b) It helps in assessing and evaluating alternative research plan
- c) It helps in keeping the focus during the research process, and act as an internal check on the progress of the research work.
- d) Research design is needed for advance planning of the method that are necessary for collecting relevant and appropriate data to be used in analysis, keeping in mind the availability of man power, money, and time.
- e) Research design has great bearing on the reliability of results.
- f) A good design helps the research to organize his ideas and give an indication about flaws and inadequacies. It helps the researcher to anticipate latent problems in the implementation of the study.
- g) It also helps to fix the boundaries of research work and thereby helps the researcher to go through in specific direction.

Q: What are the features of a good research design?

(www.prepNext.com)

Ans:

Features of a Good Research Design:

The features of a good research design are;

- (i) A good research design is reliable, with minimum bias in data collection and analysis.
- (ii) It gives minimum experimental error.
- (iii) It is flexible, efficient, appropriate, economical and effectiveness.
- (iv) It is suitable for the nature and purpose of the study.

Q: Explain the various components or parts of a research design.

(www.prepNext.com)

Ans:

Components of a Research Design:

A research design is a blue print of research activity. Generally, the components of a research design are as follows:

1. Title of the Study: The title should be informative but brief. The researcher should consider the following in selecting a title.

- a) The title should be specific to the area of the study.
- b) The title must indicate the topic of the study.
- c) The title should be as brief as possible.
- d) The language of the title should be professional.

2. Introduction: This heading should include a brief explanation of the main thrust of the problem.

3. Statement of the problem: Under this heading, the researcher should state the problem. He should state the problem using unambiguous, clear, simple and brief statement.

4. Review of Literature: Under this head the researcher mentions what is known about a problem under consideration. Here he presents a review of the previous studies. This enables him to know the different areas covered by earlier studies, to ascertain the gap and concentrate on the areas where little or no research has been carried out.

5. Scope of the study: This heading presents an idea about the coverage and extent of the study. The scope of the study is dependent on various factors such as time and finance available with the investigator and co-operation of the sample respondents etc.

6. Objectives of the study: The effort of the researcher is to specify the objectives precisely. The objectives lead to more effective investigation. After the objectives are finalised, the study can be conducted with accuracy and within the available resources.

7. Hypothesis to be tested: Hypothesis is a principle, proposition or condition which is assumed without belief in order to draw logical conclusions. Hypotheses are framed to explain observed behaviours, conditions or facts and to serve as a guide to the research process. Each hypothesis is tested individually to determine whether it is tenable or untenable.

8. Operational definition of concepts: It is important to have a clear understanding of the terms used in the study. It is also necessary to identify the variables. Variables can be independent variable and dependent variable. Independent variable is that factor which is measured, manipulated or selected by the experiments. Dependent variable is that factor which is measured to determine the effect of independent variable.

9. Geographical area to be covered: The area to be covered by the study is mentioned under this head,

10. Reference period: The period of the study is mentioned under this head.

11. Sources of data collection: The researcher first determines the kind of information needed to answer the research questions. Thereafter, he has to decide the sources from which data are to be collected for the study. The source may be primary or secondary or the both.

12. Sampling: Sampling means taking a portion of population, making observation on this small group and then generalising the findings to a large population. Small group which is observed is

called a sample and the large group is called population. The sample must be representative of the population, otherwise the findings of the study cannot be generalised.

13. Tools for collection of data: The choice of method for collecting data is influenced by the subject matter, the unit of enquiry and the extent of the study. For a simple enquiry among the cross section of population, a questionnaire is appropriate. A survey of general population involving many complex questions would require personal interviewing.

14. Plan of analysis: After collection of data, these must be converted to meaningful results by statistical analyses so that the conclusion for generalisation can be drawn from them. The researcher should express how he is going to organise the data and the techniques of analysis to be applied.

15. Research report: The results of the research study should be communicated through research report. The format of research report comprises three parts.

Part – I : Preliminary pages containing title pages, authentication sheet, preface (if any), Table of contents, List of tables (if any) and List of figures (if any).

Part – II : Body of the report which covers content chapters.

Part – III: Supplementary pages which include Bibliography, Appendix (if any) and Index (if any).

16. Financial budget: It is necessary to draft the budget showing the money needed to complete the project. The cost estimates of the project include printing, stationery, field work, mailing, processing, editing, tabulation, preparation of report and miscellaneous overheads.

Q: Write a short note on Pilot Survey. (www.prepNext.com)

Ans:

(a) PILOT SURVEY

A pilot survey is the replica of the main study. Pilot study is the preliminary study conducted on a limited sample before the original study are carried out in order to gain primary information. In this study the whole process of research is covered but on a small scale. It refers to a study which is conducted to familiarize oneself with the problem of research so that a better knowledge can be obtained about the problem.

Pilot survey is undertaken without formulating any hypothesis. It is generally made on a small sample unit. The results so obtained from pilot study must be carefully analysed. A well done and thoroughly exploited pilot study helps the researcher not only in framing a logical questionnaire but also proves to a time saving mechanism.

Advantages of Pilot Survey

The various advantages of pilot study are discussed below :

1. Pilot study helps the researcher in respondent selection procedure.
2. It helps in identifying the various problems associated with the research work.
3. It helps to build sincerity and honesty of the interviewers.
4. Pilot study provides helps in building self confidence.
5. It tests interviewer's stamina to work under conditions of personal discomfort, stress and fatigue.
6. It helps the researcher to estimate the time and cost involved in the project.

Q: Write a short note on Pre-testing.

(www.prepNext.com)

Ans:

PRE-TESTING

Pre-testing means a trial administration of instrument such as questionnaire, interview, schedule and measurement of scale in order to identify the weaknesses. Based on the observations during pre-testing, instrument is revised and then is finalised for the final use. It is a common technique and it helps the researcher to achieve the goal of the study.

Pre-testing helps the researcher to formulate the schedule/questionnaire in a proper manner and assists in testing the validity and reliability of statistical technique to be adopted for data processing and analysis.

Advantages of Pre-Testing

Advantages of conducting pre-testing are discussed below:

1. **Reveals the strengths and weaknesses of the schedule/questionnaire:** Pre-testing helps in identifying which questions in the questionnaire are good and which questions are not understood by the respondents or which questions arose defensiveness in them. Thus, pre-testing helps the investigator to identify weaknesses (if any) in the questionnaire and helps to rephrase the questions accordingly, so that information can be easily acquired from the respondents.
2. **Helps to decide form and structure of questionnaire:** Pre-testing helps the researcher in deciding the form and structure of the questions, i.e., whether the questions should be dichotomous, multiple choice or open-ended.

For any query on the subject, email at: messagerakesh@gmail.com

- 3. Resolves the problem of measurement:** It helps to resolve many mechanical problems of measurement. For example, the sequence of questions may require changes where it is found that an answer to any early question tends to affect the response to a later one, etc.
 - 4. Improve the design of questionnaire:** Pre-testing helps in designing questionnaire in terms of format, design, line spacing between questions, use of symbols for options given in the answers, quality of instructions etc.
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Different research designs can be categorized as below:

1. Research Design in Case of Exploratory Research Studies
 2. Research Design in Case of Descriptive and Diagnostic Research Studies
 3. Research Design in Case of Hypothesis-Testing Research Studies
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Q: Write short notes on:

1. Research Design in Case of Exploratory Research Studies
2. Research Design in Case of Descriptive and Diagnostic Research Studies

OR

“Research design in exploratory studies must be flexible but in descriptive studies, it must minimise bias and maximise reliability.”

Discuss.

(www.prepNext.com)

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Ans.

Research Design in Case of Exploratory Research Studies:

Exploratory research studies are also termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypothesis from an operational point of view. The major emphasis in such studies is on the discovery of ideas and insights. As such the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study.

Inbuilt flexibility in research design is needed because the research problem, broadly defined initially, is transformed into one with more precise meaning in exploratory studies, which infact may necessitate changes in the research procedure for gathering relevant data. Generally, the following three methods are used in the context of research design:

- (a) Survey of concerning literature;
- (b) Experience survey and
- (c) Analysis of 'insight-stimulating' examples.

(a) Survey of concerning literature: The survey of concerning literature helps in formulating precisely the research problem or developing hypothesis. Hypothesis stated by earlier workers may be reviewed and their usefulness be evaluated as a basis for further research. Besides, the bibliographical survey of studies, already made in one's area of interest may as well be made by the researcher for precisely formulating the problem. Sometimes the works of creative writers also provide a fertile ground for hypothesis and as such may be looked into by the researcher.

(b) Experience survey: Experience survey means the survey of people who have had practical experience with the problem to be studied. For such a survey people who are competent and can contribute new ideas may be carefully selected as respondents to ensure a representation of different types of experience. The respondents so selected may then be interviewed by the investigator. The researcher must prepare an interview schedule for the systematic questioning of informants. But the interview must ensure flexibility in the sense that the respondents should be allowed to raise issues and questions which the investigator has not previously considered. An experience survey may enable the researcher to define the problem more concisely and help in the formulation of the research hypothesis.

(c) Analysis of 'insight-stimulating' examples: Analysis of 'insight-stimulating' examples is also a fruitful method for suggesting hypothesis for research. This method consists of the intensive study of selected instances of the phenomenon in which one is interested. For this purpose the existing records, if any, may be examined, the unstructured interviewing may take place, or some other approach may be adopted. Few examples of 'insight-stimulating' cases are: the reactions of strangers, the reactions of marginal individuals, the reactions of individuals from different social strata and the like.

Thus, in an exploratory or formulative research study which merely leads to insights or hypothesis, whatever method of research design is adopted, the only thing essential is that it must continue to remain flexible so that many different aspects of a problem may be considered as and when they arise and come to the notice of the researcher.

Research Design in Case of Descriptive and Diagnostic Research Studies:

Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. As against this, studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies.

In descriptive as well as in diagnostic studies, the aim is to obtain complete and accurate information. So, the procedure to be used must be carefully planned. The research design must make enough provision for protection against bias and must maximise reliability, with due concern for the economical completion of the research study. The design in such studies must be rigid and not flexible and must focus attention on the following:

- (a) Formulating the objective of the study (what the study is about and why is it being made?)
- (b) Designing the methods of data collection (what techniques of gathering data will be adopted?)
- (c) Selecting the sample (how much material will be needed?)
- (d) Collecting the data (where can the required data be found and with what time period should the data be related?)
- (e) Processing and analysing the data.
- (f) Reporting the findings.

Precautions to be taken in case of Descriptive and Diagnostic Research Studies:

- Several methods (viz., observation, questionnaire, interviewing, examination of records, etc.), with their merits and limitations, are available for collecting the information and the researcher may use one or more of these methods. While designing data-collection procedure, adequate safeguards against bias and unreliability must be ensured. Questions must be unambiguous; interviewers must be instructed not to express their own opinion; observers must be trained so that they uniformly record a given item of behaviour.
- The problem of designing samples should be tackled in such a fashion that the samples may yield accurate information with a minimum amount of research effort.
- To obtain data free from errors introduced by those responsible for collecting them, data collecting staff must be supervised closely so that they perform their duty honestly and without prejudice. Data collected should be examined for its completeness, comprehensibility, consistency and reliability.
- To the extent possible, the processing and analysing procedure should be planned in detail before actual work is started. This will prove economical in the sense that the researcher may avoid unnecessary labour such as preparing tables for which he later finds he has no use or on the other hand, re-doing some tables because he failed to include relevant data.
- The layout of the report needs to be well planned so that all things relating to the research study may be well presented in simple and effective style. Reporting of findings must be done in an efficient manner.

Thus, the research design in case of descriptive/diagnostic studies must be prepared keeping in view the objective(s) of the study and the resources available. However, it must ensure the minimisation of bias and maximisation of reliability of the evidence collected.

Q: Differentiate between 'Research Design in Case of Exploratory Research Studies' and 'Research Design in Case of Descriptive/ Diagnostic Research Studies'. *(www.prepNext.com)*

Ans:

Research Design	Type of Study	
	Exploratory or Formulative	Descriptive/ Diagnostic
Overall design	Flexible design (design must provide opportunity for considering different aspects of the problem)	Rigid design (design must make enough provision for protection against bias and must maximise reliability)
(i) Sampling design	Non-probability sampling design (purposive or judgement sampling)	Probability sampling design (random sampling)
(ii) Statistical design	No pre-planned design for analysis	Pre-planned design for analysis
(iii) Observational design	Unstructured instruments for collection of data	Structured or well thought out instruments for collection of data
(iv) Operational design	No fixed decisions about the operational procedures	Advanced decisions about operational procedures.

Q: Discuss research design in case of hypothesis-testing research studies. (www.prepNext.com)

Ans:

Research Design in Case of Hypothesis-Testing Research Studies:

Hypothesis-testing research studies (generally known as experimental studies) are those where the researcher tests the hypothesis of causal relationships between variables. Such studies require procedures that will not only reduce bias and increase reliability, but will permit drawing inferences about causality. Usually experiments meet this requirement. Hence, research design in such studies often mean the design of experiments.

Study of experimental designs has its origin in agricultural research. Professor R. A. Fisher found that when we divide agricultural fields or plots into different blocks and then conduct experiments in each of these blocks, then the information collected and inferences drawn from them, happens to be more reliable. This fact inspired him to develop certain experimental designs for testing hypothesis concerning scientific investigations. Today, the experimental designs are being used in researches relating to phenomena of several disciplines. Since experimental designs originated in the context of agricultural operations, we still use, though in a technical sense, several terms of agriculture (such as treatment, yield, plot, block etc.) in experimental designs.

Q: What are the basic principles of Experimental Designs?

(www.prepNext.com)

Ans:

BASIC PRINCIPLES OF EXPERIMENTAL DESIGNS

Professor R. A. Fisher has enumerated three principles of experimental designs:

1. The Principle of Replication;
2. The Principle of Randomization; and
3. The Principle of Local Control.

1. The Principle of Replication: According to the Principle of Replication, the experiment should be repeated more than once. Thus, each treatment is applied in many experimental units instead of one. By doing so the statistical accuracy of the experiments is increased. For example, suppose we are to examine the effect of two varieties of rice. For this purpose we may divide the field into two parts and grow one variety in one part and the other variety in the other part we can then compare the yield of the two parts and draw conclusion on that basis. But if we are to apply the principle of replication to this experiment, then we first divide the field into several parts, grow one variety in half of these parts and the other variety in the remaining parts. We can then collect the data of yield of the two varieties and draw conclusion by comparing the same. The result so obtained will be more reliable in comparison to the conclusion we draw without applying the principle of replication. The entire experiment can even be repeated several times for better results. Replication is introduced in order to increase the precision of a study; that is to say, to increase the accuracy with which the main effects and interactions can be estimated.

2. The Principle of Randomization: The Principle of Randomization provides protection, when we conduct an experiment, against the effect of extraneous factors by randomization. In other words, this principle indicates that we should design or plan the experiment in such a way that the variations caused by extraneous factors can all be combined under the general heading of “chance.” For instance, if we grow one variety of rice, say, in the first half of the parts of a field and the other variety is grown in the other half, then it is just possible that the soil fertility may be different in the first half in comparison to the other half. If this is so, our results would not be realistic. In such a situation, we may assign the variety of rice to be grown in different parts of the field on the basis of some random sampling technique i.e., we may apply randomization principle and protect ourselves against the effects of the extraneous factors (soil fertility differences in the given case). As such, through the

application of the principle of randomization, we can have a better estimate of the experimental error.

3. The Principle of Local Control: The Principle of Local Control is another important principle of experimental designs. Under it the extraneous factor, the known source of variability, is made to vary deliberately over as wide range as necessary and this needs to be done in such a way that the variability it causes can be measured and hence eliminated from the experimental error. This means that we should plan the experiment in a manner that we can perform a two-way analysis of variance, in which the total variability of the data is divided into three components attributed to treatments (varieties of rice in our case), the extraneous factor (soil fertility in our case) and experimental error. In other words, according to the principle of local control, we first divide the field into several homogeneous parts, known as blocks, and then each such block is divided into parts equal to the number of treatments. Then the treatments are randomly assigned to these parts of a block. Dividing the field into several homogeneous parts is known as 'blocking'. In general, blocks are the levels at which we hold an extraneous factor fixed, so that we can measure its contribution to the total variability of the data by means of a two-way analysis of variance. In brief, through the principle of local control we can eliminate the variability due to extraneous factors(s) from the experimental error.