UNIT 2 DESCRIPTIVE AND EXPERIMENTAL RESEARCH

Structure

2.0 INTRODUCTION

As you studied in the previous Units, a 'research method' is a particular way of studying a problem. The features of the research problem and also the field of inquiry determine the 'method'. In this Unit we shall discuss Descriptive Method and Experimental Method of research in detail.

2.1 OBJECTIVES

After the completion of this Unit you should be able to:

- describe the steps involved in descriptive research;
- explain the characteristics and features of types of descriptive research such as survey research, documentary analysis, correlational studies and causal-comparative studies;
- describe the steps involved in experimental research; and
- identify and explain a few designs for experimental studies.

2.2 DESCRIPTIVE RESEARCH

Descriptive research studies are designed to obtain information concerning the current status of a given phenomenon. They are concerned with the existing conditions or relationships, prevailing practices, current beliefs, points of view or attitudes, processes that are going on and their effects and the developing trends.

In short, it determines the nature of a situation as it exists at the time of study. The aim of descriptive research is to describe "what exists" with respect to variables or conditions in a situation.

The descriptive research method is appropriate in behavioural sciences. Many types of behaviour that interest the researcher cannot be arranged in a realistic setting. For example, it would be unthinkable to prescribe cigarette smoking for the purpose of studying its possible relationship to throat or lung cancer, or deliberately arrange accidents, in order to evaluate the effectiveness of seat-belts or helmets in preventing serious injuries.

Although some experimental studies of human behaviour can be appropriately carried out both, in laboratory and in the field, the prevailing method used in social sciences in descriptive. Under the conditions that naturally occur at home, inside the classroom, on the playground or within the community, human behaviour can be systematically examined and analysed. This analysis may lead to the modification of factors or influences that determine the nature of human interaction. It is through this modification of factors that social institutions may become more effective influences in promoting human welfare.

2.2.1 Descriptive Research: Main Steps

In descriptive studies, we do not present private convictions and data based on casual or cursory observations. In descriptive study, we:

i) examine the problematic situation,

ii) define our problem and state our hypothesis,

iii) list the assumption upon which our hypothesis and procedures are based,

iv) select appropriate subjects and source material,

v) select or construct technique for collecting data,

vi) validate the data gathering techniques,

vii) make objective and discriminating observations,

viii) describe, analyse and interpret our data in clear, precise terms.

We, as researchers, collect evidence on the basis of some hypotheses, tabulate and summarize the data carefully, and then analyse the results thoroughly in an endeavour to draw meaningful generalization that will advance knowledge.

Collection of data

When presenting a descriptive research report, one must identify not only the kind of data obtained but also the exact nature of its population. The units that constitute a population may be people, items, events or objects. After identifying the population, one must decide whether to collect data from (a) the total population or (b) a representative sample of the population.

a) **Total population:** Obtaining information from every unit of a small population is not difficult in most instances, but the findings are not applicable to any population other than the group studied. After collecting information from every student in one particular study center, you may, draw generalizations about the average age or the kind of profession of students in the center; but, you cannot claim that these generalizations will hold true for students in any other study center. Similarly, after studying the attitude of teachers of the School of Continuing Education in IGNOU towards the Distance Education

Programme, a researcher cannot claim that the findings will hold true for teachers in other schools of IGNOU.

b) **Sample:** Obtaining information from a large population, such as all teachers in the state, is often impractical, impossible or exorbitantly costly. Contacting, observing, measuring or interviewing every unit in the group may need so much time that the data becomes obsolete before the study is complete. To overcome these difficulties, investigators often collect information from a few carefully selected units drawn from a population. While carrying out the research on Study Habits of undergraduate students of IGNOU, the researcher cannot collect data from all the 50,000 undergraduate learners. He/She will have to select a representative sample of the population. However, the sample will have to be selected from different categories of the population, viz., male/female, employed/unemployed etc. If these sample units represent accurately the characteristics of the population, generalisations based on the data obtained from them may be applied to the entire group. But selecting a representative sample is a difficult task. How to select a proper sample is the topic of discussion in Unit 1, Block 3.

Descriptive data may be expressed qualitatively (in verbal symbols) as well as quantitatively in mathematical symbols. A study may consist almost exclusively of one form or may contain both forms. Qualitative data may predominate in studies that examine the general nature of a phenomena. Qualitative studies give social scientists useful information, but verbal symbols lack precision as words do not hold the same meaning for all people, at all times, and in all contexts. However, qualitative studies need not be looked down upon; for, they help workers identify the significant factors to measure. Until these general explorations are made, measurement cannot be utilised fruitfully.

2.2.2 Types of Descriptive Research

In this sub-section, we are going to discuss various types of descriptive research. There is nothing sacrosanct about such a categorisation, but it helps us understand the phenomenon (research) more clearly.

i) **Survey studies:** Quite often, descriptive research itself is termed survey research, but it is better to think of it as a category under descriptive research.

'Survey' is probably the most widely used method for obtaining descriptive and evaluative information in social research. When trying to solve problems, non-governmental, governmental, industrial and political, organisations often conduct surveys. Detailed descriptions of existing phenomena are collected with the aim of employing the data to justify current conditions or practices or to make more intelligent plans for improving them. The objective may not only be to ascertain status, but also to determine the adequacy of status by comparing it with selected or established standards. Researchers who wish to improve existing status of health of children may survey how others have solved similar problems. At times, we need to collect all three types of information:

- Data concerning existing status, e.g., to find out the study habits of postgraduate students of IGNOU,
- Comparison of status and standards, e.g., to compare the achievement level of distance education students and conventional education students, and
- Means of improving status e.g., to find out measures to improve student support services in distance education programmes.

On the other hand, we can also limit our studies to one or two of these types.

Surveys may be broad or narrow in scope. They may be confined to a small geographical area or whole state or even the country. The scope and the depth of the survey depend primarily on the nature of the problem. The steps involved in the case of surveys are presented as follows:

a) **Selection of topic** involves the determination of what topic is to be investigated and what population is to be studied. At this stage, one also decides the methods and procedures that will be used to collect the data.

b) **Sampling** involves decision making about which people from the population are to be included in the survey. If one is to generalise from the sample to the population, it is essential that the sample selected be representative.

c) **Construction of a tool for data collection** involves writing the questions and planning the format of the instrument to be used. Among the data collection techniques used in surveys are personal interviews, questionnaires, rating scales, etc.

d) **Collection of data includes pre-testing the instrument to determine whether** it will obtain the desired data, interviewing subjects or distributing questionnaires to them, and verifying the accuracy of the data gathered.

e) **Processing and analysis of the data** includes tabulating the data, computer processing and analysis of the data, interpreting the results, and reporting the findings.

ii) **Analysis of documents:** From documents and records, we can unearth pertinent data. Documentary analysis, which is sometimes referred to as 'content', 'activity'or 'informational' analysis is very much like historical research. Both methods of investigation require that researchers examine existing records: historical research is primarily concerned with the more distant past, but descriptive research is concerned chiefly with the present.

A wide variety of documentary surveys are made. Some scholars analyse judicial decisions, state laws and rulings. Researchers may also collect data describing existing NGO's practices, processes and conditions from administrative records, committee reports and minutes of meetings, budget and financial records, etc. Documentary research produces valuable information, but the method has certain limitations, and investigators may draw faulty conclusions from the data.

Some documentary researches are of little value because the investigators fail to analyse the representative sample of source materials. Many studies do not provide information concerning the adequacy of the sample size or the conformity of the universe of the sample to the universe. If an analysis is made of newspaper editorials concerning the problems of agricultural labour, for example, the researcher must judge for himself/herself whether the newspapers selected represent the opinion of the different social, religious, economic or political groups from all the parts of the country. Very often, the write-ups are not representative in nature.

Documentary research in not without other pitfalls as well. Data do not become true reflections of reality through the magic of publication. In using documentary sources, one must bear in mind the fact that data appearing in print are not necessarily trustworthy. One must subject each documentary source material to the same rigorous external and internal criticism that a historian does. Moreover, the categories used in the available statistical material do not always coincide precisely with the variables which the researcher wants to investigate. Sometimes the definitions of categories are ambiguous, and they

may change from year to year. The boundaries of some units of analysis, e.g., villages, districts, age cohort, etc. can also change; different agencies collecting similar data do not always use exactly the same classificatory system. The data collected always reflect the orientation, concerns, self-interests, and the levels of accuracy preferred by the producers of the records, which may not be an accurate reflection of reality or behaviour.

Check Your Progress 1

List the steps involved in survey studies. Describe briefly in about 30 words the objectives of documentary analysis.

Note: a) Space is given below for your answer.

b) Compare your answer with the one given at the end of this unit.

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iii) **Correlational studies:** Human behaviour at both, individual and the social levels is characterised by great complexity. However, given the present state of social research, we understand too little of this complexity. One approach to a fuller understanding of human behaviour is to begin by testing out simple relationships between those factors and elements which are supposed to have some bearing on the phenomenon in question. The value of correlational research is that it is able to achieve this end. We know that one of the primary purposes of science, as conceived traditionally, is to discover relationships among phenomena with a view ultimately to predicting and, in some situations, controlling their occurrence.

Much of social sciences research is concerned at our present stage of development with the first step in this sequence, i.e., establishing interrelationships among variables. Correlational studies are concerned with determining the extent of relationship existing between variables. They enable us to measure the extent to which variations in one variable are associated with variations in another. We may wish to know, for example, how delinquency is related to social and class background, or whether a relationship exist between the number of years spent in full-time education and subsequent annual income, or whether there is a link between personality and achievement.

Correlational studies are generally intended to answer three questions. They are:

a) Is there a relationship between two variables (or two sets of data)? If the answer to this question is ‘yes’, then other questions follow:

b) What is the direction of the relationship? and

c) What is the magnitude of the relationship? The magnitude of the relationship is determined by the coefficient of correlation.

For instance, on the basis of his/her experience, a researcher may hypothesize that there is a relationship between performance in an intelligence test and a test of achievement in arithmetic. The correlational technique will help him test his/her hypothesis about the relationship. Pearson's product moment, one of the best known measures of association, is a statistical value of the coefficient of correlation ranging from –1.0 to +1.0, through zero and expresses relationship in quantitative form. Where the two variables fluctuate in the same direction, i.e., as one increases so does the other, a **positive** relationship is said to exist. A **negative** correlation or relationship, on the other hand, is to be found when an increase in one variable is accompanied by a decrease in the other variable. The values near zero indicate a weak relationship between the variables, whereas values closer to either +1.0 or –1.0 indicate a stronger relationship in either of directions. Thus, the coefficient of correlation, tells us something about the relationship between two variables. However, other measures exist which allow us to specify relationship when more than two variables are involved. These are known as measures of **multiple correlation** and **partial correlation.** (We will not go into details about these measures over here.)

One danger in interpreting correlations is to assume that because two variables are related in a predictable fashion to one another with a high degree of probability, they are also in a causal relationship. This is not necessarily the case. For one thing there is never more than a probable relationship between variables in any case . For another, it is quite possible for two variables to be related to one another with a high degree of probability but with a third variable accounting for the nature of relationship. Correlation must not be interpreted to mean that one variable is causing the scores in other variable to be what they are. For example, it may be found that there is a negative correlation between measures of anxiety and measures of intelligence. It should not be interpreted that there is a causative relationship between anxiety and intelligence, that is, that pupils are anxious because they are unintelligent or that pupils appear unintelligent because they are anxious. It might be that there are other underlying characteristics of individuals that tend to make some appear unintelligent and anxious, and others, intelligent and not anxious. Interpretation of such a correlation is difficult without experimental confirmation, For example, the relationship between anxiety measures and intelligence measures could be investigated experimentally by deliberately inducting anxiety in a testing situation and determining the effect on intelligence test scores.

Characteristics of correlational studies

Correlational studies can be broadly classified either as **relational studies** or as **prediction studies.** As a method, the former is particularly useful in exploratory studies in fields where little or no previous research has been undertaken. It is often a shot in the dark aimed at verifying hunches which a researcher has about a presumed relationship between some characteristics or variables. Take a complex notion like **teacher effectiveness** for example. This is dependent on a number of complex factors operating singly or in combination. Factors such as intelligence, motivation, person, perception, verbal skills, etc., come to mind as possibly having an effect on teacher outcomes. A review of the literature of research will confirm or reject these possibilities. Once an appropriate number of such possibilities has been identified in this way, suitable measures may then be chosen or developed to assess them. They are then given to a representative sample, and the scores obtained are then correlated with the complex factor that is being investigated, namely, teacher effectiveness. As it is an exploratory undertaking, the analysis will consist of correlation coefficients only. The investigation and its outcomes may then be used as a basis for further research or as sources of additional hypotheses.

In contrast to exploratory research studies, prediction studies are usually undertaken in an area having a firmer and securer knowledge base. Prediction through the use of correlational technique is based on the assumption that at least some of the factors that will lead to the behaviour to be predicted are present and measurable at the time the prediction is made. For example, since we know that IQ and General Achievement (GA) are positively correlated, we can predict with some degree of accuracy that an individual with a high IQ will probably have a high GA. To be valuable for prediction, the extent of correlation between two variables must be substantial and, of course, the higher the correlation, the more accurate the prediction.

iv) **Causal-comparative studies**: There is, at times the need to discover **how** and **why** a particular phenomenon occurs, and not confine our investigation to **what** a phenomenon is like. In this instance, the investigator tries to compare the similarities and differences among phenomena to find out what factors or circumstances seem to accompany or contribute to the occurrence of certain events, conditions or practices.

Unlike a scientist working in a laboratory, a social researcher cannot always select, control and manipulate factors that are necessary to study cause-effect relations. An investigator cannot, for example, manipulate domestic background, social class, intelligence, etc. in situations that do not allow researchers manipulate the independent variable and establish the controls that are required in "true experiments", they may conduct a causal-comparative study.

In a causal-comparative investigation, a researcher studies a real life situation in which subjects have experienced what he/she want to investigate. For example, if an investigator wants to study emotional instability, he/she does not place children in a situation where all factors are kept constant except one variable which is manipulated to determine what causes a particular type of emotional disturbance. Rather, he/she chooses children who according to a selected criterion, are 'disturbed' and compares them with emotionally stable children. After searching for factors or conditions which seem to be associated with one group and not the other, he/she may present a possible explanation of the underlying causes of the emotional problem.

Limitations of causal-comparative method

i) Lack of control is serious limitation and weakness of this method of research.

ii) It is usually difficult to identify the relevant factors causing a particular condition or phenomenon. For instance, students' liking for a teacher depends on a number of factors and a researcher may not be able to identify all the factors. He/She may only be able to identify good teaching and mastery of subject matter as some of the factors effecting students' liking for a teacher.

iii) The joint method of agreement and disagreement requires that a single factor must be the cause for the occurrence or non-occurrence of the phenomenon. But in the case of social phenomena, with which a researcher is usually concerned, this condition does not come invariably. In fact, in these situations/ events usually have multiple rather than single causes. Furthermore, a phenomenon may result not only from multiple causes but also from one cause in one instance and from another cause in another instance.

iv) When a relationship between variables is established, it is difficult to distinguish between the cause and the effect.

v) The classification of subjects into dichotomous groups for the purpose of comparison also presents problems.

vi) In comparative studies of natural situations, the researcher does not have the same control over the selection of subjects as he/she has in experimental studies. It is difficult to identify existing groups of subjects who are alike in all respects except for their exposure to one variable.

Though causal-comparative studies have many limitations, and they do not often produce precise and reliable knowledge that can be gained through rigorous experimental studies, they provide the means of tackling problems that cannot be probed in laboratory situations. Furthermore, they yield valuable information and clues concerning the nature of phenomena and are well suited to many types of field studies seeking to establish causal relationships.

Check Your Progress 2

Explain briefly the purpose of correlational studies. List the weaknesses of causal-comparative studies.

Note: a) Space is given below for your answer.

b) Compare your answer with the one given at the end of this Unit.

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2.3 EXPERIMENTAL RESEARCH

Experimental research studies are designed for establishing causal relationships. This method begins with a question concerning the relationship between two or more variables. At the same time, the researcher advances one or more hypotheses stating the nature of the expected relationship. The experiment is the event planned and carried out by the researcher to gather evidence relevant to the hypotheses.

In its simplest form an experiment has three characteristics:

i) an independent variable is manipulated,

ii) all other variables except the independent variable are held constant, and

iii) the effect of the manipulation of the independent variable on the dependent variable is observed.

The independent variable and the dependent variable(s) are important in an experiment. The independent variable is manipulated or changed by the experimenter. The variable upon which the effects of changes are observed is called the dependent variable, which is observed but not manipulated by the experimenter. The dependent variable is so named because its value is hypothesised to depend

upon, and vary with, the value of the independant variable. For example, to examine the effect of training for empowerment upon decision making, an investigator would manipulate training, the independent variable, by using different training methods in order to ascertain their effect upon decision making, the dependent variable.

2.3.1 Three Characteristics of Experimental Research

There are three essential ingredients in the conduct of an experiment: control, manipulation and observation. We shall discuss each of them as follows:

i) **Control:** Control is the first essential ingredient of experimental method. Without control, it is impossible to evaluate unambiguously the effects of an independent variable. Basically, the experimental method rests upon two assumptions regarding variables. These are:

   a) If two situations are equal in every respect except for a variable that is added to or deleted from one of the situations, any difference appearing between the two situations can be attributed to that variable. This statement is called the **law of the single variable.**

   b) If two situations are not equal, and it can be demonstrated that none of the variables is significant in producing the phenomenon under investigation, or if significant variables are made equal, then any difference occurring between the two situation after the introduction of a new variable to one of them can be attributed to the new variable. This statement is called **the law of the only significant variable.**

   The main purpose of 'control' in an experiment is to arrange a situation in which the effect of variables can be measured. The conditions to be fulfilled under the first law can be obtained more easily in physical sciences. A high degree of control is much easier to achieve in a laboratory setting than in situation outside the laboratory. In the laboratory, there is only limited number of variables which can be manipulated easily. However, as social research is concerned with human beings, there are always many variables present in situation. To attempt to reduce social problems to the operation of a single variable, is not only unrealistic but perhaps impossible as well. Fortunately, we do not require such rigorous control to be introduced in social settings, for many factors involved in such a setting may be quite insignificant and irrelevant for our study. To this extent, in social research, the law of the single significant variable is more appropriate. For example, if we were to study the effect of two methods of teaching alphabets to two groups of adult learners, we are likely to select the two groups which are identical in every respect except in the way they are taught alphabets. But it is impossible to have two groups that are identical in every respect. So, the endeavour of the researcher should be towards obtaining two groups that are as similar as possible, at least in those factors that are thought to have an effect on learning alphabets. These could be, general intelligence, motivation, reading ability, etc. Other variables that are not likely to affect achievement in learning alphabets can be ignored. Thus, in experimental studies in social research we need procedures that permit us to use to compare groups in the basis of significant variables. 'Control' is to used to indicate an experimenter's 'procedures' for eliminating the differential effects of all variables extraneous to the purpose of the study. (An extraneous variable is variable that is not related to the purpose of the study but may affect the dependent variable). The experimenter exercises controls, for instances, when the groups are made comparable on extraneous variables that are related to the dependent variable. If a variable is known to be unrelated to the dependent variable, it cannot influence the dependent variable and we do not need to control it for its effects.

ii) **Manipulation:** Manipulation of a variable is another distinguishing characteristic of experimental research. It refers to a deliberate operation performed by the researcher. In contrast to the descriptive research in which the researcher simply observes conditions as they occur naturally, the researcher in the experimental research actually sets the stage for the occurrence of the factors whose performance is to be studied under conditions where all other factors are controlled or eliminated. In social research and other behavioural sciences, the manipulation of a variable takes a characteristic form in which the experimenter imposes a predetermined set of varied conditions on the subjects. This set of varied conditions is referred to as the independent variable; the experimental variable, or the treatment variable. Then, different conditions are designed to represent two or more values of the independent variable; these may be differences in degree or differences in kind. That is, the independent variable may assure two or more values and the difference in the values may be of quantitative or qualitative nature. Methods of teaching, attitudes, socio-economic status, personality characteristics, types of motivation, etc. are some common examples of the independent variable in social research. For example, if the researcher compares two methods of teaching, then method of teaching is the independent variable and can be manipulated by the teacher. We may manipulate a single variable or a number of variables simultaneously.

iii) **Observation:** In experimentation, we are interested in the effect of the manipulation of the independent variable on a dependent variable. Observations are made with respect to some characteristics of the behaviour of the subjects employed in the research. These observations which are quantitative in nature, may constitute the dependent variable. This needs some explanation.

The dependent variable in social research is often change of some type, such as attitude towards learning. We are often interested in explaining or predicting attitude. Since attitude cannot be measured directly, we can only estimate it through measures like scores in a scale. Therefore, strictly speaking, the dependent variable is scores or observations rather than change in attitude.

Check Your Progress 3

Explain briefly the significance of control, manipulation, and observation in an experimental study.

Note: a) Space is given below for your answer.

b) Compare your answer with the one given at the end of this Unit.

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2.3.2 Steps Involved in Experimental Research

A number of steps are involved in experimental research. Here, we shall talk about four steps to reach the stage of the 'actual experiment'. Brief explanations are needed for steps 3 and 4 only. The steps are :

i) Surveying the literature related to the problem,

ii) Identifying and defining the problem,

iii) Formulating a hypotheses is an important step in experimental research. They suggest that an antecedent condition or phenomenon (independent variable) is related to the occurrence of another condition, phenomenon, event, or effect (dependent variable). To test a hypothesis, the experimenter attempts to control all the conditions except the independent variable which he/she manipulates. Then he/she observes the effect on the dependent variable presumably because of the exposure to the independent variable.

iv) Constructing an experimental plan is the next step in experimental research. This refers to the conceptual framework within which the experiment is conducted. This would involve:

- Selecting a research design,
- Selecting a sample of subjects to represent a given population, assign subjects to groups, and assign experimental treatments to the groups. (Subject implies the respondent or living organism that is studied),
- Selecting or constructing and validating instruments to measure the outcomes of the experiment,
- Stating the procedures for collecting the data and possibly conduct a pilot or "trial run" test to perfect the instruments or design, and
- Stating the statistical or null hypothesis.

The above steps bring the researcher to the stage when he/she actually conducts the experiment, applies statistical measures to the data obtained, and then test the significance of the results.

In the next sub-section, we shall take up the various designs involved in experimental method.

2.3.3 Designs of Experimental Study

A research design is very important for the researcher. A well developed design provides the structure and strategy to control the investigation and extract dependable answers to the questions raised by the problem or hypothesis. It is the nature of the problem that determines the appropriateness of the design.

Before we discuss the experimental designs, it will be relevant to look into the terms and symbols which we shall make use of.

i) X represents the independent variable, which is manipulated by the researcher; it is also referred to as the experimental variable or the treatment variable.

ii) Y represents the measure of the dependent variable. Y_1 represents the dependent variable before the manipulation of the independent variable X; it is usually a pre-test of some type administered before the experimental treatment. Y_2 represents the dependent variable after the manipulation of the independent variable X; it is usually a post-test administered to subjects after the experimental treatment.

iii) S represents the *subject* or *respondent* used in the experiment.

iv) E group refers to the *experimental group* – t he group that is given the independent variable treatment.

v) C group refers to the *control group* – the group that does not receive the experimental treatment.

vi) R indicates *random assignment* of subjects to the experimental groups and the random assignment of treatments to the groups.

There is a large number of experimental designs. Various authors have classified experimental design into certain categories. Most common categorization comprises:

- Pre-experimental Design
- True Experimental Design
- Quasi Experimental Design

Some authors like Donald Ary and others (1985) have added more categories namely

- Factorial Design
- Time Series

Various designs under the above mentioned categories are given in the table below:

Pre-Experimental	True Experimental	Quasi Experimental	Factorial Design	Time Series
• One Group Pre-test Post-test Design • Static Group Comparison	• Randomized 'Subjects' Post-test only Control Group Design • Randomized Matched Subjects, Post-test only Control Group Design • Randomized subjects Pre-test Post-test control Group Design • Solomon Four Group Design	• Non-randomized Control Group, Pre-test Post test Design • Counter Balanced Design	• Simple Factorial Design	• One Group Time Series Design • Control Group Time Series Design

However, in this section, we will bring before you only a few most frequently used designs, from each of the five categories.

2.3.3.1 Pre-experimental Design

The two designs classified as pre-experimental designs offer minimal control of extraneous variables. Still they are used quite often in social research. These designs help to illustrate the advantages of more rigorously controlled designs that are presented later.

Design 1: One Group Pre-test Post-test Design

When this design is employed, the dependent variable is measured before the independent variable or treatment is applied or withdrawn, and then measured yet again. The one group design usually involves three steps:

a) administering a pre-test measuring the dependent variable,

b) applying the experimental treatment X to the subjects, and

c) administering a post-test again measuring the dependent variable.

Differences attributed to application of experimental treatment are then determined by comparing the pre-test and post-test scores.

Pre-test	Independent variable	Post-test
Y_1	X	Y_2

Design 1: One Group Pre-test Post-test Design

To illustrate the use of this design, let us assume that we want to evaluate the effectiveness of a particular self-instructional material in Rural Development for post graduate students. How may we go about this task?

At the beginning of the academic year, the students are given a standardized test that measures the objectives of the course quite satisfactorily, following which the distance teacher then introduces the self-instructional material. At the end of the year, the students are administered the standardized test a second time. Comparing the scores of the two tests would reveal what difference the exposure to the SIM has made.

However, using only one group, as in Design 1, gives us superficial control. The major limitation of the one-group design is that, since no control group is used, the experimenter cannot assume that the change between the pre-test and the post-test scores is brought about by the experimental treatment alone. It is quite possible that some extraneous variables account for all or part of the change. For example, students experience changes with the passage of time; they grow mentally as well as physically, or they may acquire additional learning experiences that would affect the dependent variable. This extraneous variable can be thought of as **maturation** i.e., with the passage of time students get maturity and this in turn may effect achievement level. Another type of extraneous variable that can operate between the pre-test and the post-test scores and which cannot be controlled is **history.** History as a source of extraneous variances refers to the specific events that can occur between the pre-test and post-test other than the experimental treatment. In the example cited above, not receiving material regularly or illness just before the test, could decrease achievement scores. Similarly, a crucial research finding in history could increase widespread interest and hence affect the test scores. In fact, history and maturation become increasingly influential sources of extraneous variance when the time interval between Y_1 and Y_2 is long.

Another short coming of Design 1 is that it offers no way of assessing the effect of the pre-test Y_1 itself. We know that "practice effect" exists when subjects take a test a second time or take an alternate form of the test. In other words, subjects do better the second time even without any instruction or relevant discussion during the interval. This is true not only for achievement and intelligence tests but also for personality tests. In the case of personality tests, a tendency towards better adjustment is generally observed.

To sum up, Design 1 has little to recommend it; without a control group to make a comparison possible, the results obtained in a one group design are basically uninterpretable. The results of the experiment would have been dependable if there could be a comparable group i.e. control group to which SIM had not been given.

Design 2: Static Group Comparison

Design 2 utilizes two or more groups, only one of which is exposed to experimental treatment. The groups are assumed to be equivalent in all relevant aspects, they differ only in their exposure to X.

This design is often used in social research, For example, achievement of adult learners taught by a new method is compared with that of similar class taught by a traditional method.

Design 2 has a control group or groups, which permit (s) the comparison that is required for scientific respectability. If the experimental group is superior on the Y_2 measure, the researcher then has more confidence in his/her conclusion that the difference is due to experimental treatment.

However, there is a basic flaw in this design. Since neither **randomization** nor even **matching** is used to assign subjects to the experimental and control groups, we cannot be sure that the groups are equivalent prior to the experimental and control groups, we cannot be sure that the groups are equivalent prior to the experimental treatment. They may differ on certain relevant variables, and it may be these differences rather than X that are responsible for the observed change. Because we cannot be sure that the groups are equal with regard to all the factors that may influence the dependent variable, this design is considered to be lacking in the necessary control and must be classified as pre-experimental.

Group	Independent Variable	Post-test
E	X	Y_2
C	—	Y_2

Design 2: Static Group Comparison

2.3.3.2 True Experimental Designs

The following two designs, belong to the 'true experimental' design, because of the control that they provide. i.e.

i) Random assignment of subjects to the groups.

ii) Random assignment of treatment to the groups.

iii) Post-testing all the groups.

Design 3: Randomized Subjects, Post-test only Control Group Design

This particular design requires two groups to which subjects are randomly assigned and each group is assigned to a different condition. No pre-test is used; randomization controls all the possible extraneous variables. This does not mean that randomization procedures (like drawing names out of a hat, or flipping a coin) remove the extraneous variables, such as the IQ or age, which may affect the dependent variable, or control their presence. These extraneous variables still affect the inquiry; but, now, it is the laws of chance rather than the personal feature of E that operate. In fact, the larger the number of subjects used, the more equivalent or similar the groups will tend to be. Suppose a researcher wants to study the effect of instructional material on achievement in a course during a contact programme. He/she may randomly assign the students to the groups and provide treatment to one of the groups. The assigning of the treatment will be random. At the end of the contact programme he/she may test both the groups.

After the subjects are assigned to the groups, only the experimental group is exposed to the experimental treatment. Otherwise, in all other respects, the two groups remain similar. Members of both groups are then measured on dependent variable Y_2. Scores are then compared to determine the effect of X.

Group	Independent Variable	Post-test
(R) E	X	Y_2
(R) C	—	Y_2

Design 3: Randomized Subjects, Post-test only Control Group Design

The main advantage of Design 3 is randomization, which assures statistical equivalence of the groups prior to the introduction of independent variable. Design 3 provides controls for the main effects of history, maturation and pre-testing; because no pre-test is used, there can be no interaction effect of pre-test and X (treatment).

Design 4: Randomized Matched Subjects, Post-test only Control Group Design

This design is similar to Design 3 except that it uses a matching technique, rather than random assignment, to obtain equivalent groups. Subjects are matched on one or more variables that can be measured conveniently, such as IQ or reading scores. The matching variables used are generally those that have a significant correlation with the dependent variable. On the basis of these variables subjects are paired so that opposite member's/scores' are as close as possible; and then, one member of each pair is randomly assigned to one treatment and the other to the second treatment.

Group	Independent Variable	Post-test
(Mr) E	X	Y_2
(Mr) C	—	Y_2

Design 4: Randomized Matched Subjects, Post-test only Control Group Design

Matching is most useful in studies where small samples are to be used and where Design 3 is not appropriate. Also, the matched subjects' design serves to reduce the extent to which experimental differences can be accounted for by initial differences between groups. However, for matching to really become a means of control, the matching of all the potential subjects must be complete, and assignment of the members of each pair to the groups must be determined randomly. If one or more subjects should be excluded because an appropriate match could not be found, this would bias the sample. When using Design 4, it is essential to match every subject, even if only approximately, before random assignment is effected.

2.3.3.3 Quasi Experimental Design

One of the Quasi Experimental Designs is Non-randomized Control Group, Pre-test Post-test Design. You would notice that randomized control group pre-test post-test design is a true experimental design which we have presented before. The only difference on the quasi experimental design is that the groups are not randomized. Hence they are unlikely to be comparable. In fact, it is on this ground that the design becomes quasi experimental and not true experimental. Since the

rest of the design related characteristics remain common with the randomized control group pre-test post-test design of the true experimental design category, we do not need to provide any further details on this design.

Group	Pretest	Independent Variable	Post-test
E	Y_1	X	Y_2
C	Y_1	–	Y_2

2.3.3.4 Factorial Designs

A factorial design is one where two or more variables are manipulated simultaneously in order to study the independent effect of each variable on the dependent variable as well as the effects due to interaction among the several variables. Factorial designs are of two types. In the first type, one of the independent variables may be experimentally manipulated. The researcher is primarily interested in the effect of a single independent variable but he/she must take other variables into consideration which may influence the dependent variables. In the second type of design, all the independent variables may be experimentally manipulated. Factorial designs have been developed at varying levels of complexity, the simplest factorial design is the 2 by 2 (2 × 2) Design. The two independent variables have two values.

Level 1 subjects receive Treatment A and others Treatment B. Some level 2 subjects receive Treatment A and others Treatment B.

Attribute Variable X_2	Experimental Variable X_1	Variable X_2
	Treatment A	Treatment B
Level 1	Cell 1	Cell 3
Level 2	Cell 2	Cell 4

The strength of the factorial design is that it can achieve in one experiment what might otherwise require two or more separate studies.

2.3.3.5 Time Series Design

We have already discussed pre-test post-test designs. They generate one time data on the dependent variable before and after the experimental treatment. There are instances where it becomes necessary to compare changes in the trend of a particular phenomenon or process or product. For example, let us assume that learners behaviour to attitudes, achievements etc. changes over a period of time. If a specific treatment is introduced in an institution to study the change in attitude or achievement it is useful to study the trend through measurement at certain intervals before the introduction of the treatment. Instead of one time pre-test, the test is repeated three or four times before the treatment is administered. This generates data on the trend of behaviour. Similarly after the treatment is administered instead of one time post-test, the post-test is administered several times at intervals. This provides data to derive the trend in the change in behaviour. Since both, pre-tests and post-tests are used over a time series design the effect of the treatment on the dependent variable is tested by comparing the trends. This can be represented in the following form:

Y_1	Y_2	Y_3	Y_4	Y	Y_5	Y_6	Y_7	Y_8

What we have described above is one group time series design. If you add a control group and repeat the same time series measurement without the treatment of the control groups it becomes control group time series design. Similarly control group time series design is represented as:

Group									
E	Y_1	Y_2	Y_3	Y_4	X	Y_5	Y_6	Y_7	Y_8
C	Y_1	Y_2	Y_3	Y_4	X	Y_5	Y_6	Y_7	Y_8

Check Your Progress 4

Draw and compare the figures representing pre-test post-test experimental design and one group time series design.

Note: a) Space is given below for your answer.

b) Compare your answer with the one given at the end of this unit.

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2.4 LET US SUM UP

In this Unit, we studied two important research methods, viz., Descriptive Method and Experimental Method. Descriptive research describes what is the condition and involves the description, recording, analysis and interpretation of conditions that exist. We also studied various types of descriptive research, like survey, documentary analysis, correlational and causal comparative studies. Experimental research describes what will be when certain variables are carefully controlled or manipulated.

2.5 CHECK YOUR PROGRESS: THE KEY

1) The steps involved in survey studies are: selecting the topic, sampling, selection/ construction of tools of data collection, collection of data, processing of the data and analysis and interpretation of data.

   Documentary analysis can show us the existing conditions and practices of an institution and the importance of problems in an organisation.

2) Correlational studies are useful to:

   - determine the relationship between variables and
   - measure the extent to which variations in one variable are associated with the variations in another variable. The weaknesses of causal comparative studies are: lack of control, difficulty in identifying the relevant causal factors, determining their number in given phenomenon, classifying subjects into dichotomous groups for the purpose of comparison, lack of control over the selection of subjects.

3) Control is crucial to (i) evaluate unambiguously the effects of an independent variable and (ii) arrange a situation in which the effect of variables can be measured.

   Manipulation controls or eliminates the irrelevant factors and arranges a situation in which only relevant factors can be studied.

   Observations are made to study specific characteristics in the behaviour of the subjects employed in experimental research.

4) Pre-test Post-test Experimental Design

Group	**Pre -test**	**Treatment**	**Post-test**
E	Y_1	X	Y_2

One Group Time Series Design

Y_1	Y_2	Y_3	Y_4	Y	Y_5	Y_6	Y_7	Y_8

Compared to one test each before and after the treatment in pre-test post-test experimental group design, tests are repeated at specified intervals in one group time series design. Whereas time series designs compares the trends of change in the dependent variable, the pre-test post-test experimental design tests one time gain or change in the dependent variable.

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