
UNIT 4 QUANTITATIVE RESEARCH METHOD*

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4.0 INTRODUCTION

In this unit of the block, various aspects of research design will be introduced to you. Research design is said to be a blue print or frame work which is prepared before starting the actual research. It acts as a guideline for the conduction of research. They can be classified in to many types and it is the researcher's responsibility to decide which of the design will be best suited for his/her research. The unit will also explain about the various aspects of quantitative research method.

4.1 OBJECTIVES

With the help of this unit, you will be able to:

- Explain the concept of research design;
- Describe the meaning and characteristics of quantitative research;
- Discuss the difference between experimental and non -experimental research method;
- Distinguish between field experiment and field studies; and
- Describe the quasi experimental and ex post facto research.

4.2 RESEARCH DESIGN

As mentioned to you earlier that, research design is a blue print or framework of process, steps, methods and techniques selected by a researcher to carry on the research in a reasonably logical manner to fill the research gap. It refers to the methodology and tries to answer the "how" aspect of research. It is a kind of sketch which guides the researcher to the process of conduction of research. Roughly, research design deals with collection of data, measurement and analysis of data.

The researcher selects the type of research design for his/her research on basis of the nature of problem selected by him/her. The research design guides on selection of tool, collection of data and analysis of data on basis of the selected purpose of research design. An effective research design helps in minimizing error/ biases.

4.2.1 Required Elements of a Research Design

An effective research design helps the researcher to conduct a research in a more reliable way and helps towards more valid interpretations. Few of the basic elements required for an effective research design are as follows:

- There should be a clear purpose/ aim of research.
- The detail of the tools selected for the collection of data should be clearly informed.
- The settings for the research study should be clear and well informed to the researcher.
- The researcher should have a clear idea of the tentative timeline required for the overall research.
- The researcher should also know well in advance about the measurement of analysis.

- The limitations and ethical guidelines of the selected research should be clearly known to the researcher.

4.2.2 Characteristics of Research Design

Some of the characteristics of research design can be mentioned as follows:

4.2.2.1 It is Reliable

It is important that the researcher should ensure that the research design framed has accurate research questions which can help to obtain standard results. Moreover, it is expected that if a research is done on regular basis, it will yield similar results. So, these purposes can be attained only if the research design is reliable.

4.2.2.2 It is Valid

The research design provides an opportunity to select a tool which is standardized, bias free and measures what it claims to measure. Only then the tool prepared from research design can be claimed to be valid.

4.2.2.3 It is Neutral

The results obtained from the proposed research consists of responses from many individuals. So, the results obtained from the research design are free from bias, extremities and judgmental. The research design therefore yields a neutral result.

4.2.2.4 It can be Generalized

The research design helps in providing results which can be generalized and applied to the population.

4.2.3 Types of Research Design

Research design helps a researcher to follow research steps on a correct tract and achieve trustable results. As mentioned to you earlier, it is the onus of the researcher to select the correct research design which can help him/her to achieve the desired outcomes. Therefore, on basis of the selected area of the research, the researcher needs to opt the correct research design. The research design can be broadly classified as follows:

4.2.3.1 Qualitative Research Design

The qualitative research design is concerned with phenomenon and involves the investigation of the reasons of various human behavior; underlying motives and desires. It basically involves the use of in depth interviews and uses open ended questions for data collection. The research method is important in the behavioral sciences where the aim is to discover the underlying motives of human behavior. With the help of qualitative research, the researcher finds a solution to “why” a particular theory exists along with “what” respondents have to say about it. Some of the types of qualitative research are- Ethnography, Grounded Theory, Survey research and Case Study. You will come to know more about the qualitative methods in the next unit.

4.2.3.2 Quantitative Research Design

It is concerned with measurement of quantity or amount of any event, situation or incidence to collect actionable insights. Quantitative research design are applicable to phenomena that can be expressed in terms of quantity. It involves use of questionnaires and uses closed end questions for data collection. It is important in social sciences where the aim is to collect information to analyze relationship between variables, predictions and comparisons. Some of the types

of quantitative research design are- laboratory; field experiments; field studies; quasi experimental research; ex-post facto research.

4.3 INTRODUCTION TO QUANTITATIVE RESEARCH DESIGN

As mentioned to you earlier, the quantitative research method deals with objective measurements and includes statistical or numerical analysis of data collected through polls, questionnaires or surveys. The variables can be manipulated as well as controlled in the quantitative research. Basically, the variables are manipulated to examine the cause- effect relationship, comparative analysis or interventional analysis within a specified population. In a broader sense, the quantitative research designs are either descriptive (in which the scores from the participants are taken only once); the basic purpose of the study is to only establish associations between variable; the study may include a large sample in order to ensure valid results which can be generalized to the population, or experimental (in which the scores from the same participants are collected before and after treatment within a controlled situation); the sample size may be very small and purposefully chosen in experimental research. In a descriptive study, only associations between variables are established while cause- effect relationship or causality is established in experimental studies.

Further, quantitative research deals with numbers. It focuses more on convergent reasoning than on divergent reasoning which means that the researcher tries to find out solutions to a research problem with help of standardised tools and not mere by creative ideas. It mainly focuses on quantifying relationships between variables. Variables refers to any condition that can be varied like- weight, performance, time, and treatment. These variables are measured on a sample of human or animals. These variables are measured and analysed with help of statistics, such as correlation, relative frequencies, or differences between means.

4.3.1 Characteristics of Quantitative Research Design

Certain specific characteristics that are pertinent to quantitative research are as follows:

4.3.1.1 Research Questions

Based on the research problem, the researcher in the quantitative research frames clearly defined research questions and the answers to these questions are sought objectively.

4.3.1.2 Representative Sample

The researcher selects a sample of a specified population from which data is aimed to be collected. These samples are representative of the population, so that the results achieved can be generalised on the respective population accordingly.

4.3.1.3 Deals with Variables

As mentioned before, the quantitative research deals with variables and as per the requirement, the researcher manipulates (e.g. increases or decreases) and even controls the extraneous/controlled variables which can also effect the research study.

4.3.1.4 Involves Data Collection

The quantitative research deals with numbers and the data is collected by the researcher with the help of structured or standardised research instruments. The

data is analysed with help of empirical evidences. The data are collected in form of numbers, and statistics, often arranged in tables, charts, figures, or other non-textual forms.

4.3.1.5 Reliable and Valid

Since the study is done under controlled observation or scientific investigations, they can be replicated or repeated and provide similar results. The quantitative research is high on reliability. Further, as the quantitative research involves the use of standard and structured instruments (which are variable specific), they are equally valid as well.

4.3.1.6 Generalisability

Since the quantitative research design is done in a well- planned manner and are highly reliable as well as valid, the results obtained through the method can be generalized and can also effectively predict results as well as infer causal relationships.

4.3.2 Strengths of Quantitative Research Design

It is worth to be mentioned that quantitative research provides a framework to the researcher to find out relationships or conduct comparative analysis and attempts to control the environment in order to collect the required data. Some of the strengths of the quantitative research can be mentioned as follows:

- The research design provides an opportunity to collect data from a larger sample and helps in conducting broader study as well as generalization of results to a larger population.
- The research design helps the researcher to attain reliable, valid, accurate and objective results.
- The research design provides an opportunity to replicate and design similar studies.
- The research design provides an opportunity to conduct experiment under control environment and so minimizes error variance.
- The design uses close ended and structured questions which provides responses free from personal biases.

4.3.3 Limitations of Quantitative Research Design

Since the quantitative research is done in a controlled setting, it might not capture a response which might occur in a natural setting. Some of the limitations of quantitative research design are as follows:

- As mentioned, the research design lacks contextual details and response in contextual setting.
- The research is limited to statistical approach and so lacks the grounds of the process of discovery.
- The closed ended or structured questions might reflect a limited and incomplete information.
- Results might provide much narrower and sometimes superficial dataset.
- The research does not involve interview or in-depth perception of individuals, so it does not provide complete insight of the real world.
- The research might not yield natural and original response of individuals in a controlled setting.

Self Assessment Questions I

Fill in the following blanks

- 1) The quantitative research design is done in a well- planned manner and are highly
- 2) The qualitative research design is concerned with and involves the investigation of the reasons of various human behavior.
- 3) In the descriptive research the scores from the participants are taken
- 4) The is a blue print or framework of process, steps, methods and techniques selected by a researcher to carry on the research.
- 5) The quantitative research design lacks

4.4 EXPERIMENTAL AND NON-EXPERIMENTAL RESEARCH DESIGN

The Experimental and Non- Experimental research designs differ in terms of nature, process and control of variables. We will deal with both of them in the following sub sections:

4.4.1 Experimental Research Design

In an experimental research design, the researcher can manipulate the predictor variables as well as the participants as per the requirement of the research to examine the cause- effect relationship. The researcher conducts the experiment within a laboratory under controlled environment, where the sample is divided to two groups out of which one group being is treated as experimental group (the group on which experimentation or manipulation is done) and the other is placed as a placebo or control group (the group to which no manipulations or treatments are given).The laboratory-based experiment provides a high level of control and reliability. You should know here that the independent or predictor variables are those variables which can be manipulated to see their effect on the dependent variable, for example, if you vary the intensity of light and temperature to examine its effect on performance of individuals, light and temperature here are the predictor or independent variables and the performance becomes the dependent variable. A predictor variable therefore, predicts its effect on dependent variables.

4.4.1.1 Types of Experimental Research Design

Primarily, the experimental research design is of following three types, which is based on the way in which a researcher classifies the subject on basis of varying conditions and groups:

- Pre-experimental research design
- True experimental research design
- Quasi-experimental research design

The different types of experimental research design are based on the how the researcher classifies the subjects according to various conditions and groups.

4.4.1.1.1 Pre-Experimental Research Design:

The pre-experimental research design is the simplest design which follows basic steps of experiment which is conducted on a single group without the presence

of any control group. Therefore in pre-experimental design, the group is not compared with any equivalent non treatment group. The group is observed to examine the cause effect relationship between variables. This design is considered to be cost effective as it is administered on experimental group only. The pre-experimental research design is further divided into three types:

i) *One-shot Case Study Research Design*

In this type of pre experimental research design, the researcher provides some treatment to a single group and observes whether these treatments have led to some change or effect on the behaviour or response of the group. For example, in order to assess the improvement in academic performance of students (outcome variable), the teacher might give extra classes (predictor variable) to the group of students and then observe the change in their academic performance. The basic purpose of the research design is to examine whether the treatment had any effect on the outcome.

ii) *One-group Pretest-posttest Research Design*

One group pre test- post test research design is a kind of design in which the researcher compares the condition of group before and after giving a treatment. This kind of research design is an interventional design, in which the treatment serves as an intervention, for example if the researcher desires to change the unwanted behavior of a group of children, then he/she might observe the current behavior of the group, and then can administer behavioral therapy to them and then may study their behavior post the intervention. If there will be significant change in behavior of the children then the intervention will be considered to be relevant in bringing about changes in such kind of behavior. The two main features of this research design is, that, it is a one group design (consists of single group participant and all the participants are given same treatments and assessments) and there is a linear ordering in which a dependent variable before and after treatment is measured (pre test- post test design). The effect of a treatment or intervention is determined by calculating the difference between the pre and post assessment of the dependent variable.

iii) *Static-group Comparison*

In a static group comparison research design, there are two groups of participants out of which, only one group receives the treatment and the other group does not. After the treatment is administered to one group, post test scores are determined from both the groups, which is used to measure the difference, after treatment, between the two groups.

4.4.1.1.2 True Experimental Research Design

This design is considered to be the most accurate experimental research design, as it involves the analysing of proposed hypotheses with help of statistics. Experimental research design is used to establish a cause-effect relationship within a group/s. Further, there are three factors which are required to be satisfied in a true experimental research design:

- i) There is a presence of control group (which refers to the group of participants who are similar to the experimental group but experimental research rules do not apply to them) and the experimental group (which refers to those group of research participants on whom experimental research rules are applied).
- ii) There are variable/s which can be manipulated and examined by the researchers.

- iii) The sample selected is representative of population, so there is a random distribution

The experimental research method is commonly implemented in physical sciences.

4.4.1.1.3 Quasi-Experimental Research Design

The quasi experimental research design is not considered to be a true experimental research design, where, the word “quasi” refers to resemblance. The research design resembles an experimental research design but it is not exactly a true experimental research design. There is no random distribution and the participants of a group are not randomly assigned, although, there are independent variables which can be manipulated in the research design. The true experimental research design has probability samples but a quasi- experimental research design has non probability samples.

4.4.2 Non- Experimental Research Design

As the name reflects, this research design lacks the required conditions of experimental research design. In non- experimental research design, the researcher can neither control the participants nor the variables. The researchers come to conclusion with the help of observation, interaction and interpretation from the responses of the participants. So, the researcher cannot apply correlation, survey, case study or cause-effect relationships. The non- experimental research design is high on external validity and can be generalized on a larger population. This kind of research design is used when there is a requirement to study a single variable instead of statistically analyzing cause effect relationship (e.g. a study to examine how accurate is memory of the participants?). It can also be used when the researcher cannot manipulate the independent variables or the participants cannot be randomly assigned (e.g. a study to analyse whether a damage in mid brain affects the sleep pattern of participants), so it can study causal relationships without manipulating the independent variables. It can also be used in exploratory researches (e.g. a study to explore how efficiently child can be nurtured by single mothers).

Therefore, the researcher decides to use experimental research or non- experimental research design on the basis of the nature of questions. At times, same research may have the requirement of using both the researches.

4.5 LABORATORY EXPERIMENT AND FIELD EXPERIMENT

As mentioned to you earlier that experiment is observation under controlled conditions. Researchers try to control extraneous conditions either within laboratory settings (closed boundary) or in natural settings (open environment) while conducting experimental research. You will come to know about both of them in the following sub sections:

4.5.1 Laboratory Experiments

Laboratory experiments are those experiments which are conducted within a laboratory setting, where accurate measurements are possible. The researchers/ experimenters have a sound control over extraneous variables and they can manipulate independent variables as well. Therefore, the laboratory experiment uses a standardized procedure, in which the participants are randomly allocated to

each independent variable group. Example of laboratory experiment conducted in psychological research is the Milgram's experiment on obedience. The laboratory experiment is advantageous because it involves standardized procedure; it can be replicated; control of extraneous variables is possible; cause-effect relationship can be established. Though it is not aloof from disadvantages because it is conducted in artificial setting which may lessen the ecological validity as the participant might not behave as they would have behaved in real life setting. Further, there might be an influence of experimenter's bias or demand characteristics may act as confounding variable and affect the result.

4.5.2 Field Experiments

The field experiments are conducted in natural setting within the environment of the participants. Since, it is an experimental research, the experimenter can manipulate independent variable, but has no control on extraneous variables. The example of field experiment done in the field of psychology is Hofling's hospital study on obedience. The advantages of field experiment are- The behavior reflected by participants in real life setting is natural and spontaneous; the chances of demand characteristics to affect the result are low; it has higher ecological validity than the laboratory experiment. The disadvantage of this experimental research design is that, it has no control over extraneous variable which might affect the results; since it is done in natural setting, it is difficult to be replicated.

Field Studies: These researches are non-experimental in nature, as the researcher do not manipulate any variable, and every thing is studied in natural settings. The data can be collected from a large number of samples through face-to-face interviews, surveys, or direct observation. The data collected is specific to a particular issue/problem. The researcher carefully plans the procedure of research and ensures that the data is accurate, valid, and collected efficiently. The data is analysed and interpreted accordingly. The advantages of field studies are that, they can be used in studies where manipulation of variable is not possible, e.g. manipulation age of sample is not possible; it is also useful in areas where manipulation of independent variables are not ethical e.g. depression. However, the disadvantage of this research design are that, there are possibilities of ethical challenges like, deception, involved in the study; there are more chances of sampling bias; there may be influence of extraneous variables in the study. The field study is more like analysis of an existing situation at a place.

In order to make the concept of the research design (laboratory experiment, field experiment and field study) you may have a look at Table No. 4.1:

Table 4.1 : Differences between laboratory experiment, field experiment and field study

| Laboratory Experiment | Field Experiment | Field Studies |
|--|--|---|
| Experiments are conducted under controlled setting | Experiments are not conducted under controlled setting | Researches are conducted under natural environment |
| Experimenter can manipulate independent variables as well as control extraneous variables. | Experimenter can control independent variables but has no control over extraneous variables. | Researcher has can neither manipulate independent variables nor control extraneous variables. |
| Ecological validity is lowest. | Ecological validity is comparatively higher. | Has very high ecological validity. |

| | | |
|---|--|---|
| We can infer causal conditions, as their internal validity is high. | Depending on their the level of control of extraneous variables they may have high internal validity and accordingly we may infer causal conditions. | We cannot infer causal conditions, as their internal validity is low. |
| The generalisibility of the findings is limited. | The results can be generalized to the population under study. | The results can be generalized to larger sections of people. |

4.6 EX POST FACTO RESEARCH DESIGN

An ex post facto research design is a design in which researches are done to infer the causes of an event that has already occurred. The research design is also known as ‘after the fact’ research which is considered as quasi-experimental because the participants cannot be randomly assigned. The participants can be grouped on basis of characteristics like age, weight and compared with reference to independent and dependent variables, yet, it is not a true experiment because it lacks random assignment. For example, a researcher is interested to study the influence of height on self-esteem levels in adults. So the participants would be separated into differing groups (short height, medium height and tall) and measure their self esteem levels. This is an ex post facto design because a pre-existing characteristic (height) was used to form the groups.

Self Assessment Questions II

Fill in the following blanks

State whether the following statements are ‘True’ or ‘False’:

- 1) An ex post facto research design is a design in which researches are done to infer the causes of an event that has already occurred. ()
- 2) Laboratory experiments are not conducted under controlled setting. ()
- 3) In field study, the researcher can control independent variables but has no control over extraneous variables. ()
- 4) The quasi experimental research design is not considered to be a true experimental research design. ()
- 5) In true experimental design, the group is not compared with any equivalent non treatment group. ()

4.7 LET US SUM UP

It can be summed up from the above discussion that, research design is a blue print of the actual research and needs to be prepared well in advance, before conducting the actual research. There are several advantages of research design. Research design can be categorised in to several types. The researcher needs to select the research design on basis of the problem selected by him/her. We also discussed about different types of research design, their advantages and disadvantages.

4.8 UNIT END QUESTIONS

- 1) What is research design? Describe the required elements of a research design.
- 2) Discuss the characteristics of quantitative research design.
- 3) Point out the advantages and disadvantages of quantitative research design.
- 4) Describe the types of experimental research design.
- 5) Differentiate between laboratory experiment, field experiment and field studies.

4.9 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) reliable as well as valid
- 2) phenomenon
- 3) only once
- 4) research design
- 5) contextual details and response in contextual setting

Self Assessment Questions II

- 1) True
- 2) False
- 3) False
- 4) True
- 5) False

4.10 GLOSSARY

Independent Variable: Independent variable is one that cause some change in the value of dependent variable.

Extraneous Variable : Independent variable that are not related to the purpose of the study but may affect the dependent variable.

Experimental Group : Group in which subject receive treatment.

Control group : Subjects in an experiment who do not receive treatment.

Factor : The independent variable of an experiment.

Level : A particular value of an independent variable.

Treatment : Particular set of experimental condition.

Random assignment : Unbiased assignment process that gives each subjects an equal chance of being placed in any groups.

Counterbalancing : Controlling for order and sequence effect by arranging that subject experience the various condition in different orders.

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