
UNIT 4 EXPERIMENTAL RESEARCH

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4.0 OBJECTIVES

After reading this Unit, you will be able to:

- define experimental research and explain key concepts associated with it, such as variables, experimental group, cause-effect relation, validity;
- formulate a research design for experimental method and chalk out its various stages, and know its various methods;
- data generation and collection, data analysis; interpolation and drawing inference to prove, disprove or modify a hypothesis; and
- Identify situations where it is applicable in social sciences with special focus as library and information sciences.

4.1 INTRODUCTION

There was a time when research connoted only experimental research in a laboratory. Indeed the first impression of a scientific method is somewhat laboratory work or trial. Scientific method of research itself is synonymous with experimental work. Though scientific method has wide range and includes many other methods such as survey, or historical methods, but still many students and researchers confuse it with only the experimental and laboratory methods.

Scientific method of research was first advanced by the English philosopher and statesman Francis Bacon (1561-1626) in his book *Novum Organum* (1620). This consists in direct and systematic observation, interpolation of facts and generalization to formulate theories by deductive logic. His emphasis was on direct observation and verification rather than to accept without questioning prevailing views of religion or secular (e.g. of Aristotle) authorities.

4.2 EXPERIMENTATION

The literal meaning of experiment is to do sometime new or first time, to test something or put something on trail. For example, a government may start a scheme on experimental basis to know its viability. We do many things first on experimental basis to study their effectiveness and defects.

But strictly speaking the experimental method is central to scientific method or positivist approach to discovery of knowledge. It is to study cause-effect relation between two entities (called variables) by direct observation and measurement. The cause - effect relation can be studied under controlled conditions, so a laboratory provides an ideal place for such studies. It is not to say that experimental work cannot be carried out outside a laboratory in natural situations. For example, a chemist may work in a laboratory, but an astronomer will have to observe natural and uncontrolled phenomena when it occurs while sitting in his observatory.

4.2.1 Concept and Definition

Experimental method of research is employed to establish and quantify cause-effect relationship between two known variables. Variable is an element, which is under study in phenomena. Broadly speaking these is of two types: independent (casual) and dependent (effected) variables.

Types of Experimental design: In fact there are three stages of experimental research design:

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

Most appropriate type of research design depends upon the type of problem under investigation; how much it is liable to be kept under control by the experimenter; and whether the phenomena can be simulated or replicated with due authenticity.

In nutshell experimental method allows hypothesis formulation on the basis of long observation and literature survey (inductive logic), and then to use deductive logic to apply to particular instances.

Self Check Exercise

1) Define experimental method. Explain what do you understand by a variable.

- Note:** i) Write your answer in the space given below.
ii) Check your answer with the answers given at the end of the Unit.

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4.3 HYPOTHESIS

It is an informal or educated guess or a hunch on relation between two variables conceived on the basis of sufficient knowledge of ground reality i.e. by some long observation of a phenomena whether social or natural, i.e., by inductive logic.

Null Hypothesis

To empirically study correlation between two variables a null hypothesis is formed. A null hypothesis is an assumption that no difference exists between two variables. In other words there is no statistically difference between experimental and control groups.

Self Check Exercise

2) What is hypothesis? Describe null hypothesis.

- Note:** i) Write your answer in the space given below.
ii) Check your answer with the answers given at the end of the Unit.

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4.4 RESEARCH PROCEDURE

To study the co-relation between two variables in an observed phenomena, a sample is formulated of the population/entities or situation under study.

4.4.1 Sampling

Sampling is necessary if the population under study is too large to be experimented upon. A sample is a homogenous and representative of this population under study. It has to be formed carefully by a statistical method. If the sample is not homogeneously representative of this population with an error margin of 5%. It is an acceptable margin.

4.4.2 Experimental and Control Groups

The sample in divided into two randomly formed groups as follows:

Experimental Group

Group or entity which is exposed or treated to study and subsequently to measure changes in the dependent variable.

It is a similar group which is left in natural condition. It is not given any treatment or exposure. Changes in the experimental group are compared and contrasted with the static or controlled group. Diagrammatically we can put it as:

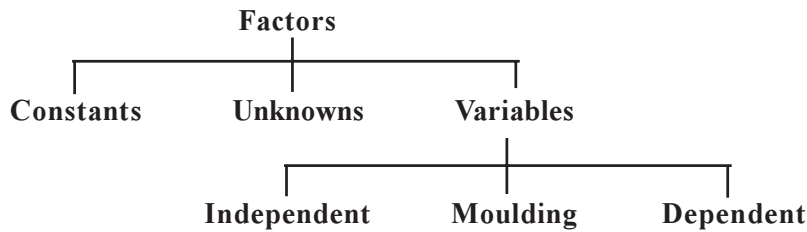


Fig. 4.1: Factors affecting Research

4.5 EXAMPLE

Let us take the example “Impact of weather on the use of the traditional (print) library”.

In this case weather is the independent variable, and library use is a dependent variable. Null hypothesis is “weather has no effect on the library use”. Independent variable is weather as it cannot be manipulated but the researcher chooses the days with varying weather conditions. Equal number of normal weather days is taken to form a control group. Number of users is dependent variable. Dependent variable is the factor that is effected and measured to draw inference.

There may be unknown variables, which may effect the dependent variables. This hidden or intervening element is not measured but does effect the dependent variable. That is to say in real situation and complex phenomena there cannot be one to one relation. In our case it could be a day of a festival or some other attractive event in the town where people are likely to throng and thus may cause a low attendance on the library. Thus varying weather conditions may not be all which account for the variation in the number of library users. In a laboratory setting or controlled condition these is high possibility of minimizing this confounding or intervening variable. In natural setting it cannot be controlled. In our case due care will have to be taken to eliminate this variable and select the days of otherwise having equal chances of being visited by the users.

4.6 VALIDITY

Literally it refers to logical soundness and consequent acceptability of an entity or research results. In experimental research it is of two types:

4.6.1 Internal Validity

It refers to the accuracy of observation and measurement of the dependent variable only under the impact of independent variable. Internal validity is high when all the confounding variables are identified and kept under control. Laboratory research is high in internal validity as the independent variables can be controlled effectively while changes in the dependent variable can be measured minutely; and intervening variables can be kept under check.

4.6.2 External Validity

It refers to use generalisability of the results i.e. the degree of their universality. Laboratory experiments are low in external validity whereas field experiments are high in external validity.

Self Check Exercise

3) Define validity. What are its different types?

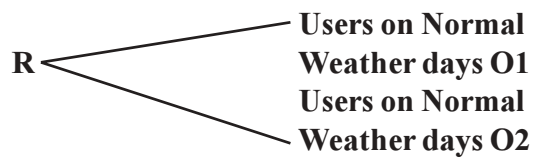
- Note:** i) Write your answer in the space given below.
 ii) Check your answer with the answers given at the end of the Unit.

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4.7 DESIGN OF THE EXPERIMENT

In any experimental research the independent variable is divided into two groups refer back to the example “on the impact of the weather on the use of library” as given in section 4.6.

This observation or experiment may be repeated on different days to collect more data. O1 and O2 are number of visitors on these days.

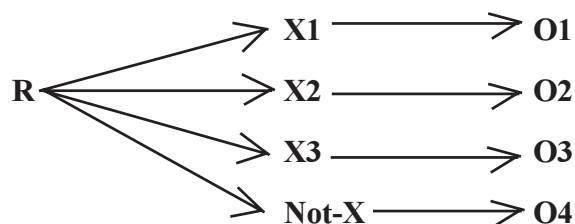


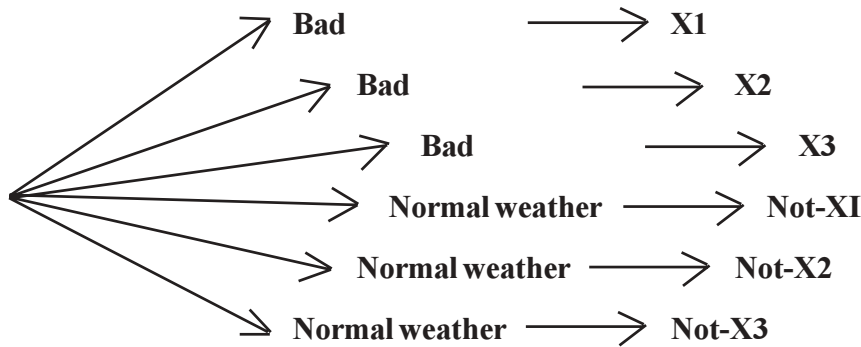
4.7.1 Randomisation

It refers to the sample selection as a pure chance. As a necessary precondition, both the good and bad weather days should be selected randomly to ensure that both these days should be selected and otherwise are at equal footing to attract users. It is to provide level ground to both the groups i.e. experimental and control.

The whole population or the sample is divided into two equivalent groups to study the difference in the conditions of the two equivalent groups: that is one put to experiment and the other control group left free or in natural state.

To get valid results the experiment may be repeated with different groups (in our case different libraries of the city or in different cities), or on different days in a same library. This will ensure better external validity of results. For each experiment observations are recorded and compared; and inference is drawn of the relation between cause (weather condition) and effect (number of users). This way causal relation between two variables can be studied. Statistical tests are applied to results, and conclusions are drawn regarding the effect of bad weather on the number of users visiting the library. To make the results generalizable we should have more than one experimental groups and, control group or we can have repeated or different control groups as follows:





In this case bad weather days should be of equally bad weather.

4.8 ANOTHER EXAMPLE

In library situation we can study the comparative retrieval power of different classification systems say CC and DDC as applied to a given collection, say sociology. In this case we will classify this collection both by CC and DDC and will try retrieving documents on randomly selected topics of sociology. Retrieval is dependent variable while classifications are independent variables. Hidden variable may be the efficiency of the classifier in correct classification of documents.

4.9 LIMITATIONS OF EXPERIMENTAL METHOD

An experiment conducted in a laboratory under artificial conditions may not truly represent a situation. It is too simplistic to consider that there are only two variables. In natural sciences it works where other variables can be kept under control. In behavioural or social sciences the situation is too complex as best put by John W. Best (p. 92).

Despite its appealing simplicity and apparent logic, it did not provide an adequate method for studying complex problem. It assumed a highly artificial and restricted relationship between single variables. Rarely, if ever, are human events the result of single causes. They are usually the result of the interaction of many variables, and an attempt to limit variables so that one can be isolated and observed proves impossible.

Hence, there are many limitations and suppositions when applied to social situations including library and information management. Human beings cannot be put to experimentation on many psychological and ethical grounds. Human beings when under a test or observation can easily manipulate their natural behaviour. They cannot be put in test tubes and titrated like chemicals. Then a human being experimenter has naturally inherent biases (likings and dislikings) when other humans are concerned. They tend to take sides in heart of hearts. Hence observations and conclusions may not reflect the objective reality.

4.10 ETHICS OF RESEARCH

A researcher has to observe some cautions, courtesies and moralities when human beings and animals are under study:

- It is necessary to take prior permission from them when an individual human being is under study. Purpose and aim of research must be further explained to them, along with any risk factor involved.

- Their right to privacy must be respected. Information collected from them should be used only for the purpose of research. It must not be passed on to someone else.
- Animals should not be subjected to any cruelty.
- As per his/her own conduct is involved, the researcher must not manipulate data to prove some thing. Objectivity and selflessness must be above all. Data may be made available to peers and reviewers, if under any suspicion or question.

Self Check Exercise

4) Enumerate the limitations of experimental method.

- Note:** i) Write your answer in the space given below.
ii) Check your answer with the answers given at the end of the Unit.

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4.11 SOME PROBLEMS FOR RESEARCH

You could do research on the following problems by experimental method in the area of library and information management.

- 1) Investigate the relation between retrieval of information on the Internet and level of IT training of the researchers.
- 2) Study the correlation between library orientation course and effective use of the library.

In this case parameters of “effective library use” must be defined. To design this research, make two groups of users formed randomly. One group may be given a library orientation course of stipulated duration, and other group of freshers is not subjected to any such training. Design a scale to measure effectiveness of the library and see if there is any difference between the two groups.

4.12 SUMMARY

Experimental method of research is to study the correlation between two variables under controlled conditions. It investigates how one variable (independent) effects the other (dependent) variable. This is known as hypo-deductive method which is a classic method of research. On the basis of some observation and literature survey a hypothesis is formed. In testing the hypothesis under controlled conditions and observation of data the thesis is supported or not supported i.e. decision are based probability rather than certainty. However this method has limitations in social sciences as in such situations there is a highly complex interplay of multiplicity of tangled variables. Two social variables cannot be easily isolated and studied. Human biases cannot be avoided; nor humans can be titrated like chemically in a lab. Emotions are always overriding and results can be easily manipulated by the investigators.

A researcher has to observe some ethics. Objectivity of data collection and true publication of results is foremost. If human beings are under study their prior and explicit permission must be taken. No body should be intimidated, bribed or exploited to get their consent. Animals should not be but to physical cruelty or mental harassment. Sources of data must be made to others when asked or questioned.

4.13 ANSWERS TO SELF CHECK EXERCISES

- 1) Experimental method is central to scientific method or positivist approach to discovery of knowledge. It is to study cause-effect relation between two entities (called variables) by direct observation and measurement under controlled conditions generally in a laboratory. It can also be carried out outside the laboratory also.
- 2) A hypothesis is a formal affirmative statement predicting a single research outcome, a tentative explanation of the relationship between two or more variables. Null hypothesis states a relationship between two variables where there is no significant difference between the experimental and control groups.
- 3) Literally it refers to logical soundness and consequent acceptability of an entity or research results. In experimental research it is of two types viz. internal and external validity. It refers to the accuracy of observation and measurement of the dependent variable only under the impact of independent variable. Internal validity is high when all the confounding variables are identified and kept under control. Laboratory research is high in internal validity as the independent variables can be controlled effectively while changes in the dependent variable can be measured minutely; and intervening variables can be kept under check. It refers to use generalisability of the results i.e. the degree of their universality. Laboratory experiments are low in external validity whereas field experiments are high in external validity.
- 4) Limitations of experimental method are in creating a control group. This is particularly true of social sciences where the population is human beings. Other limitation lies in validity of the observations in social sciences as human beings may not be observed exactly.

4.14 KEYWORDS

- Control Group** : Group/population/subjects not exposed to any treatment. It also forms independent variable.
- Experimental Group** : Group of population/subjects exposed to treatment and observation to measure the change. It is dependent variable.
- Empirical Knowledge** : Knowledge based on objective observation and experience as contrasted from intuitive or authority centered knowledge.
- Hypothesis** : A statement, based on an informed guess, predicting relations between two or more variables. Every experimental research starts with a hypothesis to prove or disprove it.
- Randomisation** : It is a statistical process of sample formation to ensure natural and representative membership in a sample of the whole population. Generalization of results depends much upon the randomization.

- Sample** : A representative population under study formed in case the field of research is too vast to be studied wholly.
- Validity** : A measure of accuracy of results and their generalization to other situations.

4.15 REFERENCES AND FURTHER READING

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