EXPERIMENTAL RESEARCH

INTRODUCTION:

The experimental method in educational research is the application and adaptation of the classical method of experimentation. It is a scientifically sophisticated method. It provides a method of investigation to derive basic relationships among phenomena under controlled condition or, more simply, to identify the conditions underlying the occurrence of a given phenomenon. Experimental research is the description and analysis of what will be, or what will occur, under carefully controlled conditions.

Experimenters manipulate certain stimuli, treatments, or environmental conditions and observe how the condition or behaviour of the subject is affected or changed. Such manipulations are deliberate and systematic. The researchers must be aware of other factors that could influence the outcome and remove or control them in such a way that it will establish a logical association between manipulated factors and observed factors.

Experimental research provides a method of hypothesis testing. Hypothesis is the heart of experimental research. After the experimenter defines a problem he has to propose a tentative answer to the problem or hypothesis. Further, he has to test the hypothesis and confirm or disconfirm it.

Although, the experimental method has greatest utility in the laboratory, it has been effectively applied non-laboratory settings such as the classroom. The immediate purpose of experimentation is to predict events in the experimental setting. The ultimate purpose is to generalize the variable relationships so that they may be applied outside the laboratory to a wider population of interest.

Characteristics of Experimental Method

There are four essential characteristics of experimental research: (i) Control, (ii) Manipulation (iii) Observation, and (iv) Replication.

Control: Variables that are not of direct interest to the researcher, called extraneous variables, need to be controlled. Control refers to removing or minimizing the influence of such variables by several methods such as: randomization or random assignment of subjects to groups; matching subjects on extraneous variable(s) and then assigning subjects randomly to groups; making groups that are as homogenous as possible on extraneous variable(s); application of statistical technique of analysis of covariance (ANCOVA); balancing means and standard deviations of the groups.

Manipulation: Manipulation refers to a deliberate operation of the conditions by the researcher. In this process, a pre-determined set of conditions, called independent variable or experimental variable. It is also called treatment variable. Such variables are imposed on the subjects of experiment. In specific terms manipulation refers to deliberate operation of independent variable on the subjects of experimental group by the researcher

to observe its effect. Sex, socio-economic status, intelligence, method of teaching, training or qualification of teacher, and classroom environment are the major independent variables in educational research. If the researcher, for example, wants to study the effect of 'X' method of teaching on the achievement of students in mathematics, the independent variable here is the method of teaching. The researcher in this experiment needs to manipulate 'X' i.e. the method of teaching. In other words, the researcher has to teach the experimental groups using 'X'method and see its effect on achievement.

Observation: In experimental research, the experimenter observes the effect of the manipulation of the independent variable on dependent variable. The dependent variable, for example, may be performance or achievement in a task.

Replication: Replication is a matter of conducting a number of sub experiments, instead of one experiment only, within the framework of the same experimental design. The researcher may make a multiple comparison of a number of cases of the control group and a number of cases of the experimental group. In some experimental situations, a number of control and experimental groups, each consisting of equivalent subjects, are combined within a single experiment.

EXPERIMENTAL DESIGNS

Experimental design is the blueprint of the procedures that enable the researcher to test hypotheses by reaching valid conclusions about relationships between independent and dependent variables. Thus, it provides the researcher an opportunity for the comparison as required in the hypotheses of the experiment and enables him to make a meaningful interpretation of the results of the study. The designs deal with practical problems associated with the experimentation such as: (i) how subjects are to be selected for experimental and control groups, (ii) the ways through which variables are to be manipulated and controlled, (iii) the ways in which extraneous variables are to be controlled, how observations are to be made, and (iv) the type of statistical analysis to be employed.

Variables are the conditions or characteristics that the experimenter manipulates, controls, or observes. The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to study their relationships to the observed phenomena. The dependent variables are the conditions or characteristics that appear or disappear or change as the experimenter introduces, removes or changes the independent variable. In educational research teaching method is an example of independent variable and the achievement of the students is an example of dependent variable. There are some confounding variables that might influence the dependent variable. Confounding variables are of two types; intervening and extraneous variables.

Intervening variables are those variables that cannot be controlled or measured but may influence the dependent variable. Extraneous variables are not manipulated by the researcher but influence the dependent variable. It is impossible to eliminate all extraneous variables, but sound experimental design enables the researcher to

more or less neutralize their influence on dependent variables. There are various types of experimental designs. The selection of a particular design depends upon factors like nature and purpose of experiment, the type of variables to be manipulated, the nature of the data, the facilities available for carrying out the experiment and the competence of the experimenter. The following categories of experimental research designs are popular in educational research:

(i) Pre-experimental designs – They are least effective and provide little or no control of extraneous variables.

(ii) True experimental designs – employ randomization to control the effects of variables such as history, maturation, testing, statistical regression, and mortality.

(iii) Quasi-experimental designs – provide less satisfactory degree of control and are used only when randomization is not feasible.

(iv) Factorial designs- more than one independent variables can be manipulated simultaneously. Both independent and interaction effects of two or more than two factors can be studied with the help of this factorial design.

Symbols used:

In discussing experimental designs a few symbols are used.

E – Experimental group

C – Control group

X – Independent variable

Y – Dependent variable

R – Random assignment of subjects to groups

Yb – Dependent variable measures taken before experiment / treatment (pre-test)

Ya – Dependent variable measures taken after experiment/ treatment (Post-test)

Mr – Matching subjects and then random assignment to groups

INTERNAL AND EXTERNAL EXPERIMENTAL VALIDITY:

Validity of experimentation: An experiment must have two types of validity: internal validity and external validity:

Internal validity:

Internal validity refers to the extent to which the manipulated or independent variables actually have a genuine effect on the observed results or dependent variable and the observed results were not affected by the extraneous variables. This validity is affected by the lack of control of extraneous variables.

External validity:

External validity is the extent to which the relationships among the variables can be generalized outside the experimental setting like other population, other variables. This validity is concerned with the generalizability or representativeness of the

findings of experiment, i.e. to what population, setting and variables can the results of the experiment are generalized.

Factors affecting validity of experimentation:

In educational experiments, a number of extraneous variables influence the results of the experiment in way that are difficult to evaluate. Although these extraneous variables cannot be completely eliminated, many of them can be identified. Campbell and Stanley (1963) have pointed out the following major variables which affect significantly the validity of an experiment:

History: The variables, other than the independent variables, that may occur between the first and the second measurement of the subjects (Pre-test and post test).

Maturation: The changes that occur in the subjects over a period of time and confused with the effects of the independent variables.

Testing: Pre-testing, at the beginning of an experiment, may be sensitive to subjects, which may produce a change among them and may affect their post-test performance.

Measuring Instruments: Different measuring instruments, scorers, interviewers or the observers used at the pre and post testing stages; and unreliable measuring instruments or techniques are threats to the validity of an experiment.

Statistical regression: It refers to the tendency for extreme scores to regress or move towards the common mean on subsequent measures. The subjects who scored high on a pre-test are likely to score relatively low on the retest whereas the subjects who scored low on the pre-test are likely to score high on the retest.

Experimental mortality: It refers to the differential loss of subjects from the comparison groups. Such loss of subjects may affect the findings of the study. For example, if some subjects in the experimental group who received the low scores on the pre-test drop out after taking the test, this group may show higher mean on the post-test than the control group.

Differential selection of subjects: It refers to difference between/among groups on some important variables related to the dependent variable before application of the experimental treatment.

CONTROLLING EXTRANEOUS AND INTERVENING VARIABLES:

All experimental designs have one central characteristic: they are based on manipulating the independent variable and measuring the effect on the dependent variable. Experimental designs result in inferences drawn from the data that explain the relationships between the variables. The classic experimental design consists of the experimental group and the control group. In the experimental group the independent variable is manipulated. In the control the dependent variable is measured when no alteration has been made on the independent variable. The dependent variable is measured in the experimental group the same way, and at the same time, as in the control group. The prediction is that the dependent variable in the experimental group will change in a specific way and that the dependent variable in the control group will not change.

Controlling Unwanted Influences:

To obtain a reliable answer to the research question, the design should eliminate unwanted influences. The amount of control that the researcher has over the variables being studied varies, from very little in exploratory studies to a great deal in experimental design, but the limitations on control must be addressed in any research proposal.

Extraneous Variables:

Extraneous variables are variables that can interfere with the action of the independent variable. Since they are not part of the study, their influence must be controlled. In the research literature, the extraneous variables also referred to as intervening variables, directly affect the action of the independent variable on the dependent variables. **Intervening variables** are those variables that occur in the study setting. They include economic, physical, and psychological variables. Therefore, it is important to control extraneous variables to study the effect of independent variable on dependent variable. We must be very careful to control all possible extraneous variables that might intervene the dependent variable.

Methods of controlling extraneous variables include:

- randomization
- homogeneous sampling techniques
- matching
- building the variables into the design.
- Statistical control

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