

# EXPERIMENTAL METHOD

## Introduction to experimental method

The word experimental research has a range of definitions. ' The experimental method is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures any change in other variables. In the strict sense, experimental research is what we call a true experiment. ' This is an experiment where the researcher manipulates one variable, and control/randomizes the rest of the variables. It has a control group, the subjects have been randomly assigned between the groups, and the researcher only tests one effect at a time.

## Experimental research as a scientific method

- Deriving verified functional relationships among phenomena
- Variation (effect) on a dependent variable
- Observation (what will occur?) under controlled conditions
- Formal treatment is carried
- An experiment is conducted
- Pure and quasi experimental

## Basic assumptions behind the experiment

### The law of single variable:

This law states that if two situations are equal in all respects except for an independent variable, any change between two situations can be attributed to the independent variable.

- When two situations are similar in every respect
- One element added or one subtracted from one
- Any difference developed at the end is the result of the operation
- The concept of cause and effect is an example of an experimental study

## Types of Experimental Design

There are two basic types of research design:

- True experiments
- Quasi-experiments

The purpose of both is to examine the cause of certain phenomena.

True experiments, in which all the important factors that might affect the phenomena of interest are completely controlled, are the preferred design. Often, however, it is not possible or practical to control all the key factors, so it becomes necessary to implement a quasi-experimental research design.

## Similarities between true and quasi-experiments:

- Study participants are subjected to some type of treatment or condition
- Some outcome of interest is measured

The researchers test whether differences in this outcome are related to the treatment

### **Differences between true experiments and quasi-experiments:**

In a true experiment, participants are randomly assigned to either the treatment or the control group, whereas they are not assigned randomly in a quasi-experiment

In a quasi-experiment, the control and treatment groups differ not only in terms of the experimental treatment they receive, but also in other, often unknown or unknowable, ways. Thus, the researcher must try to statistically control for as many of these differences as possible

Because control is lacking in quasi-experiments, there may be several "rival hypotheses" competing with the experimental manipulation as explanations for observed results

### **Types of variables in experimental research**

EM functioning around variables:

- Variable – subject to change – different value
- IV: manipulated
- DV: observed/response
- MV: special IV - modifying
- CV: neutralized controlled
- Intervening: All can't be controlled

EM functioning around variables:

Example:

- Among students of the same age and intelligence, skill performance is directly related to the number of practice traits particularly among boys but less directly among girls
- IV: Number of practice traits
- DV: Skill performance
- MD: Sex
- CV: Age, intelligence
- IntV: Learning

### **Designing experimental studies**

Experimental method: sophisticated way of research

- Plan a strategy for investigation (determine the variables)
- Study should be valid, objective, accurate and economically
- Experimental design sets up a framework
- Adequate tests to test the relations among variables
- Assign the active variables:
  - An active variable is a variable that is manipulated by the investigator. It's designed to shine light on some part of a question or problem, and its usefulness comes in the way it can be controlled by a researcher. Because of that, an active variable changes in a well-defined and carefully manipulated way over the course of an experiment.
- Specify the statistical tools and analysis
- Determine the controlling experimental variables

- The need for precision – ‘true study’

## **Procedures in experimental method**

Basic principles of experimental design:

- Randomization:
  - Valid estimate
  - Experimental error
  - Minimize bias
  - Independence of variances
- Replication:
  - Repeated treatment
  - Increase precision
  - Estimate + reduces error
- Local Control:
  - Homogenous groups
  - Size + shape (S+G errors)

## **Characteristics of a good experimental design**

### **The essential characteristics:**

- Observed treatment effects are unbiased estimates
- Quantitative description - ‘true’ – ‘precision’
- Objective test of a specified hypothesis
- Minimum “cost” broadly conceived

### **Decisions to be made in planning the experiment**

- Define the ‘treatments’
- Selection or exact definition of the population to be investigated
- Selection of a criterion
- Identification of the factors to be controlled and the level or levels at which each is to be controlled
- Final restatement of the problem
- Selection of a specific experimental design

## **Checking for errors in experimental method**

### **Various types of errors possible**

- Chance Error
  - Individual differences
  - Sampling errors
  - Measurement errors
- Systematic errors
  - Researcher’s bias
  - Hawthorne effect
- Avoid errors

- Maximize variance (IV)
- Control variance (EV)
- Minimize error (random)

## **Major designs in experimental research**

### **Simple random design**

- Simple - treatment effects
- Randomization at all levels
- Eliminating 'subject' error
- Choosing subject from population
- Divided into groups of three
- Assigned to a treatment

### **Treatment X level design**

- Control over intra-subject
- Stratified sampling technique
- Equate the groups

### **Subject X treatment design**

- All treatments to the same subjects
- Eliminate inter-subject differences - 'subject' error
- Precise than Simple Random Design/Treatment X Level design

### **Random replication design**

- Basic experiment is replicated
- Independent subject sample
- Repeating experiment on sub-population
- Each replication (different group)

### **Group within treatment design**

- Large members of finite groups (education)
- Each treatment to independent random sample
- Establishing generalization
- Eliminating contamination

### **Factorial design**

- Two or more cross classification of treatments
- Variables are simultaneously studied
- Common features with Treatment X Level design