

Chapter 4

Foundation of Hypotheses

The second step in the research process of social study is to formulate hypotheses. The hypothesis is a tentative solution of a problem. The research activities are planned to verify the hypothesis and not to find out the solution of the problem or to seek an answer of a question. It is very essential to a research worker to understand the meaning and nature of hypothesis. The researcher always plan or formulate a hypothesis in the beginning of the problem.

MEANING OF HYPOTHESIS

The word hypothesis is made up of two Greek roots which mean that it is some sort of 'sub-statements', for it is the presumptive statement of a proposition, which the investigation seeks to prove. The scientist observes the man of special class of phenomena and broods over it until by a flash of insight he perceives an order and intelligent harmony in it. This is often referred to as an 'explanation' of the facts he has observed. He has a 'theory' about particular mass of fact. This theory when stated testable proposition formally and clearly subjected to empirical or experimental verification is known as a hypothesis. The hypothesis furnishes the germinal basis of the whole investigation and remains to the end its corner stone, for the whole research is directed to test it out by facts. At the start of investigation the hypothesis is a stimulus to critical thoughts offers insights into the confusion of phenomena. At the end it comes to prominence as the proposition to be accepted or rejected in the light of the findings. The word hypothesis consists of two words:

Hypo + thesis = Hypothesis

'Hypo' means tentative or subject to the verification and 'Thesis' means statement about solution of a problem.

The world meaning of the term hypothesis is a tentative statement about the solution of the problem. Hypothesis offers a solution of the problem that is to be verified empirically and based on some rationale.

Another meaning of the word hypothesis which is composed of two words:

'Hypo' means composition of two or more variables which is to be verified.

'Thesis' means position of these variables in the specific frame of reference.

This is the operational meaning of the term hypothesis. Hypothesis is the composition of some variables which have some specific position or role of the variables i.e. to be verified empirically. It is a proposition about the factual and conceptual' elements. Hypothesis is called a leap into the dark. It is a brilliant guess about the solution of a problem.

A tentative generalization or theory formulated about the character of phenomena under observation are called hypothesis. It is a statement temporarily accepted as true in the light of what is known at the time about the phenomena. It is the basis for planning and action- in the research for new truth.

DEFINITIONS OF HYPOTHESIS

The term hypothesis has been defined in several ways. Some important definitions have been given in the following paragraphs:

1. Hypothesis

A tentative supposition or provisional guess “It is a tentative supposition or provisional guess which seems to explain the situation under observation.”
– James E. Greighton

2. Hypothesis

A Tentative generalization.

A Lungberg thinks “A hypothesis is a tentative generalisation the validity of which remains to be tested. In its most elementary stage the hypothesis may be any hunch, guess, imaginative idea which becomes the basis for further investigation.”

3. Hypothesis: Shrewd Guess

According to John W. Best, “It is a shrewd guess or inference that is formulated and provisionally adopted to explain observed facts or conditions and to guide in further investigation.”

4. Hypothesis: Guides the Thinking Process

According to A.D. Carmichael, “Science employs hypothesis in guiding the thinking process. When our experience tells us that a given phenomenon follows regularly upon the appearance of certain other phenomena, we conclude that the former is connected with the latter by some sort of relationship and we form an hypothesis concerning this relationship.”

5. Hypothesis

A proposition is to be put to test to determine its validity:

Goode and Han, “A hypothesis states what we are looking for. A hypothesis looks forward. It is a proposition which can be put to a test to determine its validity. It may prove to be correct or incorrect.

6. Hypothesis

An expectation about events based on generalization:

Bruce W. Tuckman, “A hypothesis then could be defined as an expectation about events based on generalization of the assumed relationship between variables.”

7. Hypothesis

A tentative statement of the relationship between two or more variables:

“A hypothesis is a tentative statement of the relationship between two or more variables. Hypotheses are always in declarative sentence form and they relate, either generally or specifically variable and variables.”

8. Hypothesis

A theory when it is stated as a testable proposition. M. Verma, “A theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as a hypothesis.”

9. Hypothesis

A statement temporarily accepted as true :

Barr and Scates define as, “A hypothesis is a statement temporarily accepted as true in the light of what is, at the time, known about a phenomena, and it is employed as a basis for action in the search for new truth, when the hypothesis is fully established, it may take the form of facts, principles and theories.”

10. Hypothesis

A testable proposition or assumption.

George, J. Mouly defines that, “Hypothesis is an assumption or proposition whose testability is to be tested on the basis of the computability of its implications with empirical evidence with previous knowledge.”

11. Hypothesis

Tentative relationship of two or more variables either normative or casual:

“A hypothesis is defined as a statement for the tentative relationship of two or more variables. The relationship of the variables may either be normative or causal relationship. It should be based on some rationale.”

ASSUMPTION, POSTULATE AND HYPOTHESIS

The terms assumption. postulate and hypothesis occur most frequently in the research literature, but are often confused by research scholars. Hence these terms need clear explanation.

- (a) **Assumption:** Assumption means taking things for granted so that the situation is simplified for logical procedure. Assumptions are not the very ground of our activity as the postulates are. They merely facilitate the progress of an agreement a partial simplification by introducing restrictive conditions. For example, the formulas of Statistics and measurement are based on number of assumptions. Assumption means restrictive conditions before the argument can become valid. Assumptions are made on the basis of logical insight and their truthfulness can be observed on the basis of data or evidences. The postulates are the basis and form the original point of an argument whereas assumptions are a matter of choice and less use, we make them more free will and our argument be a general proposition or convention.
- (b) **Postulate:** Postulates are the working beliefs of most scientific activity. The mathematician begins by postulating a system of numbers which range from 0 to 9 and can permute and combine only thereafter. Similarly ‘Hull’s Theory of Reinforcement’s is based on eight postulates of behaviour of an organism. With many people God and Spirit is a postulate of the good life or godly life. Postulates are not proven; they are simply accepted at their face value so that their basic work for the discovery of other facts of nature can begin.
- (c) **Hypothesis:** A hypothesis is different from both of these. It is the presumptive statement of a proposition which the investigator seeks to prove. It is a condensed generalization. This generalization requires a knowledge of principles of things or essential characteristics which pertain to entire class of phenomena.

The theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as hypothesis.

The hypothesis furnishes the germinal basis of the whole investigation and remains to test it out by facts.

The hypothesis is based on some earlier theory and some rationale whereas postulates are taken as granted true. An assumption is the assumed solution of a major problem. It may be partially true.

The scientific research process is based on some hypotheses. The nature sciences and mathematics are based on postulates. The statistic is based on some assumptions which are considered approximate science. The assumptions are helpful in conducting a research work in behavioural sciences.

OBSERVATION VERSUS SPECIFIC AND GENERAL HYPOTHESIS

Hypotheses are often confused with observation. These terms refer to quite different things. An observation refers to what is...that is to what is seen. From observation researcher may infer. For example a researcher may go into a school and after looking around. Observe that most of the students are back. From that observation he may infer that the school is located in a poor neighbourhood. Though the researcher does not know that the neighbourhood is poor, he expects that the majority of people living there are poor. Then he has formulated a specific hypothesis setting forth an anticipated relationship between two variables like race and income level. For the test of this hypothesis researcher could walk around the neighbourhood, observe the home and the income levels. After observation he provides support for this specific hypothesis for this researcher might make a general hypothesis. The second hypothesis represents a generalization and must be tested by making observation as was the specific hypothesis. Since it would be impossible to observe all universe or population, thus, the researcher will take a sample and reach conclusion on a probability basis for the verification of hypothesis being true or not.

There is some difference between specific and general hypothesis. Specific hypothesis requires fewer observations for testing than the general hypothesis.

For testing purpose a general hypothesis is reformulated to a more specific one.

NATURE OF HYPOTHESIS

The following are the main features of a hypothesis:

1. It is conceptual in nature. Some kind of conceptual elements in the framework are involved in a hypothesis.
2. It is a verbal statement in a declarative form. It is a verbal expression of ideas and concepts, it is not merely idea but in the verbal form, the idea is ready enough for empirical verification.
3. It has the empirical referent. A hypothesis contains some empirical referent. It indicates the tentative relationship between two or more variables.
4. It has a forward or future reference. A hypothesis is future oriented. It relates to the future verification not the past facts and informations.
5. It is the pivot of a scientific research. All the research activities are designed for its verification.

The nature of hypothesis can be well understood by differentiating it with other terms like assumption and postulate.

FUNCTIONS OF HYPOTHESIS

The following are the main functions of hypothesis in the research process suggested by H.H. Mc. Ashan :

1. It is a temporary solution of a problem concerning with some truth which enables an investigator to start his research work.
2. It offers a basis in establishing the specifics what to study for and may provide possible solutions to the problem.
3. Each hypothesis may lead to formulate another hypothesis.
4. A preliminary hypothesis may take the shape of final hypothesis.
5. Each hypothesis provides the investigator with definite statement which may be objectively tested and accepted or rejected and leads for interpreting results and drawing conclusions that is related to original purpose.

The functions of a hypothesis may be condensed into three. The following are the threefold functions of a hypothesis:

- (a) To delimit the field of the investigation.
- (b) To sensitize the researcher so that he should work selectively, and have very realistic approach to the problem.
- (c) To offer the simple means for collecting evidences to the verification.

IMPORTANCE OF A HYPOTHESIS

1. *Hypothesis as the Investigator's "Eyes"*: Carter V. Good thinks that by guiding the investigator in further investigation it serves as the investigator's "Eyes" in seeking answers to tentatively adopted generalization.
2. *It Focuses Research*: Without it, research is unfocussed research and remains like a random empirical wandering. It serves as necessary link between theory and the investigation.
3. *It Places Clear and Specific Goals*: A well thought out set of hypothesis is that they place clear and specific goals before the research worker and provide him with a basis for selecting sample and research procedure to meet these goals.
4. *It Links Together*: "It serves the important function of linking together related facts and information and organizing them into wholes."

– Good Barr and Scates

5. *It Prevents Blind Research*: "The use of hypothesis prevents a blind search and indiscriminate gathering of masses of data which may later prove irrelevant to the problem under study."

– P. V. Young

6. *As a Sort of Guiding Light*: A hypothesis serves as a powerful beacon that lights the way for the research work.

George J. Mouley thinks that Hypotheses serve the following purposes:

1. They provide direction to research and prevent the review of irrelevant literature and the collection of useful or excess data.

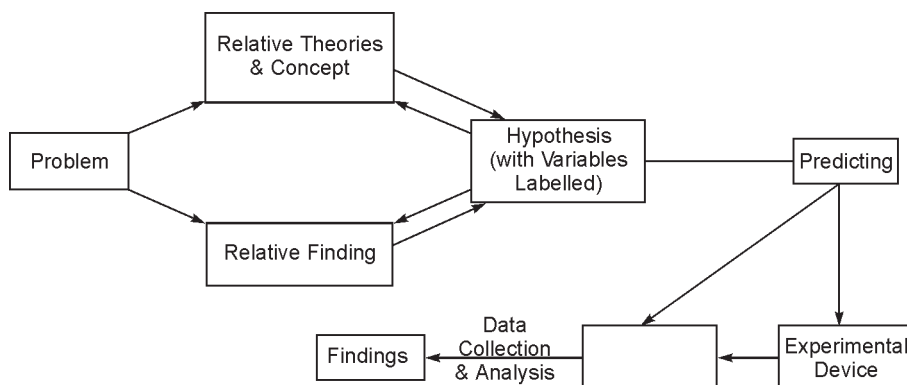
2. They sensitize the investigator certain aspects of situation which are irrelevant from the standpoint of the problem at hand.
3. They enable the investigator to understand with greater clarity his problem and its ramification.
4. They serve as a framework for the conclusive-in short a good hypothesis:
 - (a) Gives help in deciding the direction in which he has to proceed.
 - (b) It helps in selecting pertinent fact.
 - (c) It helps in drawing conclusions.

D.B. Van Dalen advocates the Importance of Hypothesis in the following ways:

1. Hypotheses are indispensable research instrument, for they build a bridge between the problem and the location of empirical evidence that may solve the problem.
2. A hypothesis provides the map that guides and expedites the exploration of the phenomena under consideration.
3. A hypothesis pin points the problem. The investigator can examine thoroughly the factual and conceptual elements that appear to be related to a problem.
4. Using hypothesis determines the relevancy of facts. A hypothesis directs the researcher's efforts into a productive channels.
5. The hypothesis indicates not only what to look for is an investigation but how to obtain data. It helps in deciding research design. It may suggest what subjects, tests, tools, and techniques are needed.
6. The hypothesis provides the investigator with the most efficient instrument for exploring and explaining the unknown facts.
7. A hypothesis provides the framework for drawing conclusions.
8. These hypotheses simulate the investigator for further research studies.

Bruce W. Tuckman presents the importance of Hypothesis in the Research Spectrum :

Research begins with a problem and utilization of both theories and findings in arriving at hypothesis. These hypotheses contain variables which must be labelled and then operationally defined to construct predictions. These steps might be considered the logical stages of the research. These stages are followed by methodological stages, which culminate in the development of research design and development of measures and finally in the finding themselves.



The Research Spectrum

KINDS OF HYPOTHESES

Hypotheses vary in form and some extent, form is determined by some function. Thus a working hypothesis or a tentative hypothesis is described as the best guess or statement derivable from known or available evidence. The amount of evidence and the certainty or quality of it determine other forms of hypotheses. In other cases, the type of statistical treatment generates a need for a particular form of hypothesis.

The following kinds of hypotheses and their examples represent an attempt to order the more commonly observed varieties as well as to provide some general guidelines for hypothesis, development and statement. There are four kinds of hypotheses: (a) Question (b) Declarative Statement (c) Directional Statement and (d) Null form or Non-Directional.

- (a) **Question form of Hypotheses:** Some writers assert that a hypothesis may be stated as a question, however, there is no general consensus on this view. At best, it represents the simplest level of empirical observation. In fact, it fails to fit most definitions of hypothesis. It is included here for two reasons: the first of which is simply that it frequently appears in the lists. The second reason is not so much that question may or may not qualify as a hypothesis. There are cases of simple investigation and search which can be adequately implemented by raising a question, rather than dichotomize hypothesis forms into acceptable/rejectable categories. The following example of a question is used to illustrate the various hypothesis forms:

Is there a significant interaction effect of schedule of reinforcement and extroversion on learning outcomes?

- (b) **Declarative Statement:** A hypothesis may be developed as a declarative which provide an anticipated relationship or difference between variables. The anticipation of a difference between variables would imply that the hypothesis developer has examined existing evidence which led him to believe a difference may be anticipated as processes additional evidence.

The following is an example of this form of hypothesis-

H : There is significant interaction effect of schedule of reinforcement and extroversion on learning outcomes.

It is merely a declaration of the independent variables effect on the criterion variable.

- (c) **Directional Hypothesis:** A hypothesis may be directional which connotes an expected direction in the relationship or difference between variables. The above hypothesis has been written in directional statement form as follows:

H : Extrovert learns better through intermittent schedule of reinforcement whereas introvert learns through continuous schedule of reinforcement.

The hypothesis developer of this type appears more certain of his anticipated evidence than would be the case if he had used either of the previous examples. If seeking a tenable hypothesis is the general interest of the researcher, this kind of hypothesis is less safe than the others because it reveals two possible conditions. These conditions are matter of degree. The first condition is that the problem of seeking relationship between variables is so obvious that additional evidence is scarcely needed. The second condition derives because researcher has examined the variables very thoroughly and the available evidence supports the statement

of a particular anticipated outcomes. An example of the obviously safe hypothesis would be 'hypothesis' that high intelligence students learn better than low intelligent students. The above hypothesis is in the directional statement form but it requires evidence for the relationship of these two variables reinforcement and personality.

- (d) **Non-Directional Hypothesis:** A hypothesis may be stated in the null form which is an assertion that no relationship or no difference exists between or among the variables. This form null hypothesis is a statistical hypothesis which is testable within the framework of probability theory. It is also a non- directional form of hypothesis. The following are the examples of null form of hypothesis

H_0 : There is no significant interaction effect of schedule of reinforcement and extroversion on learning outcomes.

H_0 : There is no significant relationship between intelligence and achievement of students.

Recent trend is to employ or develop null hypotheses in research work of education and psychology. A null hypothesis accepted is tentatively to stating that on the basis of evidence tested it could be that there is no difference. If the null hypothesis is rejected, there is a difference but we do not know the alternative or the differences. In this form of hypothesis, researcher has not to anticipate or give the rationale for the declaration or directional form. Secondly, it does not make researcher biased or prejudiced. He can be objective about the expected outcomes of the research or findings.

Actually this is a form of hypothesis but is a statistical hypothesis which is self explanatory-null hypothesis means zero hypothesis. A researcher has not to do anything in developing such form of hypothesis. In the process of reflective thinking research hypothesis is second step whereas null hypothesis is fifth step of research process.

In order to accommodate the object of the inquiry for extracting this information, a null hypothesis is an appropriate form. A null hypothesis does not necessarily reflect the expectations of the researcher so much as the utility of the null form as the best fitted to the logic of chance in statistical knowledge or science.

A statistical hypothesis must be testable within the framework of probability theory. The theory requires one or the other of two hypotheses forms: the 'null' form and the 'delta' form.

The null form is the no difference form i.e. there is no difference or relationship between or among variables under certain conditions.

The 'delta' form for a test hypothesis is simply that A is greater or lesser than B under conditions C, D.....A null form or a delta form which specifies only A and B variables in the relationship permits only a bivariate analysis which is not very sophisticated research analysis. The development of computer assisted data analysis permits the manipulation of a number of variables represented in the C, D..., n conditions of the difference or relationship.

General hypothesis is second step and null hypothesis is the fifth step of research process. Null hypothesis provides the basis of accepting or rejecting the general hypothesis.

General Hypothesis: Programmed instruction is effective then the traditional method in terms of learning outcomes.

General Hypothesis: Structural method is more effective than the lecture method of teaching in English.

Null Hypothesis is a statistical hypothesis which is used in analysing the data. It assumes that observed difference is attributable by sampling error and true difference is zero.

<i>Null Hypothesis</i>	<i>Programmed Method</i>	<i>Lecture Method</i>
Mean	M_1	M_2
S. D.	σ_1	σ_2
Size	N_1	N_2

$$H_0 \rightarrow (M_1 = M_2) \text{ or } (M_1 - M_2 = 0)$$

The statistical tests of significance are used to accept and reject the null hypothesis. If it is rejected, the general hypothesis is accepted.

Occam's razor has given a principle of economy in scientific explanation which requires for given set of observations so that generalization can be made.

This class of hypothesis is known as null hypothesis so-called because of it 'nullifies' the positive argument of the findings or non-directional statement of the generalization.

This type of hypothesis is also termed as statistical hypothesis or non-directional hypothesis or zero hypothesis because it denies the existence of any systematic principles apart from the effect of chance. This hypothesis assumes that no or zero difference exists between the two population means or the treatments.

$$H_0 \rightarrow (\mu_1 = \mu_2 = 0) \text{ or } (\mu_1 = \mu_2)$$

The observed difference between the two samples means is attributable to chance factor or sampling error.

The symbol H_0 represents the Null-Hypothesis. An alternative formulation of the hypothesis is to assert that the two samples drawn from population having the same mean. The null hypothesis is a trial hypothesis asserting that no difference exists between population parameters. Thus it involves two types of errors.

	H_0	H_1
Accept	Type I or A	Correct
Accept	Correct	Type II or B

Two Types of Errors

Type I error (a error) : When an alternative hypothesis H_1 may be accepted and H_0 is rejected. It shows that obtained difference exists and not due chance or sampling errors.

Type II error (b error) : When null hypothesis H_0 is accepted and alternative hypothesis H_1 is rejected. It indicates that obtained difference is due to chance or sampling error.

CHARACTERISTICS OF A GOOD HYPOTHESIS

A good hypothesis must possess the following main characteristics:

1. A good hypothesis is in agreement with the observed facts.
2. A good hypothesis does not conflict with any law of nature which is known to be true.

3. A good hypothesis is stated in the simplest possible term.
4. A good hypothesis permits of the application of deductive reasoning.
5. A good hypothesis shows very clear verbalization. It is different from what is generally called hunch.
6. A good hypothesis ensures that the methods of verification are under control of the investigator.
7. A good hypothesis guarantees that available tools and techniques will be effectively used for the purpose of verification.
8. A good hypothesis takes into account the different types controls which are to be exercised for the purpose of verification.
9. A good hypothesis ensures that the sample is readily approachable.
10. A good hypothesis indicates clearly the role of different variables involved in the study.
11. A good hypothesis maintains a very apparent distinction with what is called theory law, facts, assumption and postulate.

VARIABLES IN A HYPOTHESIS

A hypothesis is made testable by providing operational definitions for the terms or variables of the hypothesis. For a testable hypothesis there are two important things :

1. Variables, and
2. Operational definitions.

Variables

There are five types of variables. Among students of the same age and intelligence, skill performance is directly related to the number of practice trials particularly among boys but less directly among girls. In such a hypothesis the variables which must be considered are:

- (i) Independent variable – number of practice trails.
- (ii) Dependent variable – skill performance.
- (iii) Moderator variable – sex.
- (iv) Control variable – age, intelligence.
- (v) Intervening variable – learning.

- (i) **The Independent Variable:** The independent variable which is a stimulus variable or input operates either within a person or within environment to affect his behaviour. It is that factor which is measured, manipulated. or selected by the experimenter to determine its relationship to an observed phenomena.

If a researcher is studying the relationship between two variables X and Y. If X is independent variable, then it affects another variable Y: So the characteristics of independent variables are:

- (a) It is the cause for change in other variables.
 - (b) Independent variables are always interested only it affects another variable, not in what affects it.
- (ii) **The Dependent Variable:** The dependent variable is response variable or output. It is an observed aspect of the behaviour of an organism that has been stimulated. The dependent variable is that factor which is observed and measured to determine the effect of the

independent variables. It is the variable that will change as a result of variations in the independent variable. It is considered dependent because its value depends upon the value of the independent variable. It represents the consequence of change in the person or situation studied.

Relationship Between Independent and Dependent Variables: Most experiments involve many variables when two continuous variables are compared, as in correlation studies, deciding which variable to call independent and which dependent is sometimes arbitrary. In such cases variables are often not labelled as independent or dependent since there is no real distinction. Independent variables may be called factor and their variation may be called levels.

- (iii) **The Moderator Variable:** The term moderator variable describes a special type of independent variable a secondary independent variable selected for study to determine if it affects the relationship between the primary independent variable and the dependent variable.

The moderator variable is defined as that factor which is measured, manipulated or selected by the experimenter to discover whether it modifies the relationship of independent variable to an observed phenomena. The sex and rural urban generally function as moderator variables.

- (iv) **Control Variable:** All the variables in a situation can not be studied at the same time, some must be neutralized to guarantee that they will not have a differential or moderating effect on the relationship between the independent and dependent variables. These variables whose effects must be neutralized or controlled are known as control variables. They are defined as those factors which are controlled by experimenter to cancel out or neutralize any effect they might otherwise have on the observed phenomena. While the effects of the control variables are neutralized, the effect of moderator variables are studied.

Certain variables appear repeatedly as control variables, although they occasionally serve as moderator variables. For example sex, intelligence and socio-economic status are three subject variables that are commonly controlled, noise, task order and task content are common control variables in the situation.

- (v) **Intervening Variable:** Each independent, moderator, and control variable can be manipulated by the experimenter and each variation can be observed by him as it affects the dependent variable. Often these variables are not concrete but hypothetical, the relationship between a hypothetical underlying or intervening variable and dependent variable.

An intervening variable is that factor which affects the observed phenomenon but cannot be seen and measured or manipulated, Its effect must be inferred from the effects of the Independent and moderator variables on the observed phenomena. The attitude, learning process, habit and interest function as Intervening variables.

Hypothesis

Teachers given more positive feedback-experiences will have more positive attitudes towards children than teachers given fewer positive feedback-experiences.

Independent Variable–Number of positive feedback experiences for teacher.

Intervening Variable–Teacher’s self esteem or habit pattern.

Dependent Variable–Possessiveness of teacher’s attitude towards students.

The researcher must operationalized his variables in order to study them and conceptualize his variables in order to generalize from them. Researchers often use the labels independent, dependent,

moderator, and control to describe operational statements of their variables. The intervening variables always refer to a conceptual variable that which is being affected by the independent, moderator control and dependent variables.

The intervening variable can often be discovered by examining a hypothesis. They are usually abstract in nature.

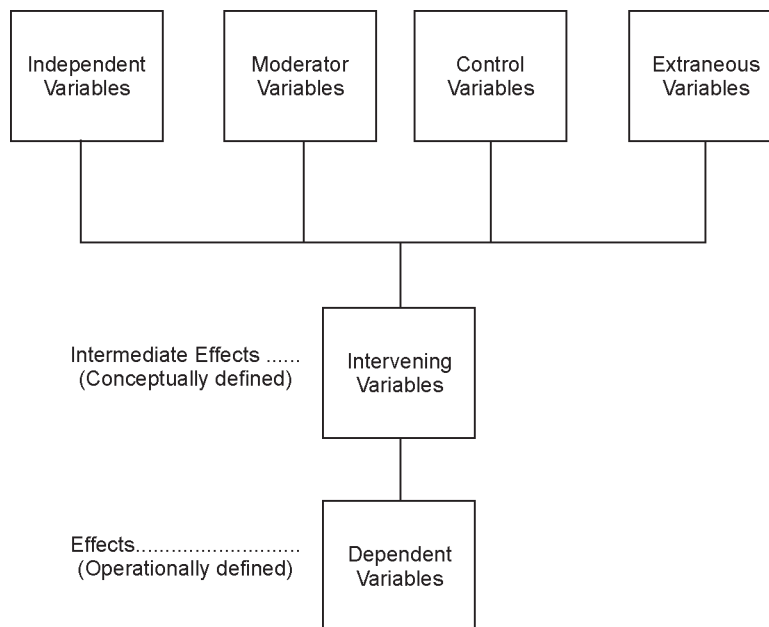
Independent, moderator and control variables are inputs or causes, the first two being these that are studied while the third, control variables are neutralized or ‘eliminated’. At that other end, dependent variables represent effects or it is also known as criterion variable while intervening are conceptualizations which intervene between operationally stated causes, and operationally stated effects.

The Research Variables Combined

The various research variables interact among themselves. The Independent, moderator, and control variables are under the researcher’s control. They cause an impact within the subject. The impact is referred to as the intervening variable. In addition, the extraneous variables have an impact upon this Intervening variable. Such extraneous variables are not under the researcher’s control, their presence weakens a study. One of the goals of a researcher is to remove as many significant factors as possible from the extraneous variables category by bringing them into the categories of moderator and control variables. Such a process of removing extraneous variables strengthens a study.

The Variables in the Research Process

Causes (operationally defined)



The intervening variable is merely hypothesized. It is abstract in nature. It cannot be visually observed. It is defined in conceptual terms. It is produced by some combination of the casual variables in the top row of the figure. It produces the effect or dependent variable. Every experimental study has at least one independent variable and one dependent variable. Both of these variables should be explicitly

stated in the hypothesis and in the research predictor. If either the treatment or the outcome variable is too complex to be stated succinctly, further operational definitions of these variables can be included in the methods section of a report. Every study has also an intervening variable, and often there can be more than one intervening variable. The intervening variable is, not stated in operational terms, but ratter conceptual explanation for the observed results. Intervening variables are normally not stated in the hypothesis or research prediction. Sometimes intervening variables are only vaguely described or are not mentioned at all.

Every study does not contain moderator and control variables. When such variables are contained in a study, they should be operationally defined. Moderator and control variables are stated in the research hypothesis and in the research prediction. Often the operational definitions further explanation in the method section of a report.

Identify each of the research variable from the following hypothesis-

High school students who study English for two years will develop better, Hindi vocabulary, skills than those who do not study English. Independent Variable - Studying English vs. not studying it.

Dependent Variable – Vocabulary skills.

Moderator – Hindi class placement (advanced vs. non-advanced).

Control – High School students.

Intervening variable – Increased ability or learning style.

Some Considerations For Variables Choice

After selecting the independent and dependent variables the researcher must decide which variables are to be included as moderator variables and which are to be excluded or hold constant as Control variables. He must decide how to treat the total part of the other variables (other than the independent). That might effect the dependent variables. In making these decisions which variables are 'in' and which are 'out' he should take into account three kinds of considerations:

1. *Theoretical Consideration*: In treating as a moderator variable, the researcher learns how it interacts with the independent variable to produce differential effects on the dependent variable. In term of theoretical base researcher is working and in term of what he is trying to find out in a particular experiment, certain variables highly qualify as the moderator variables. In choosing a moderator variable a researcher should ask: Is the variable related to the theory with which I am working? How helpful would it be to know if an interaction exists? How likely is there to be an interaction?
2. *Design Consideration*: The questions which relate to the experimental design which has been chosen and its adequacy for controlling for sources of bias, the researcher should ask the following question:
Have my decision about moderator and control variables met the requirements of experimental design in terms of dealing with the source of validity?
3. *Practical Consideration*: A researcher can only study so many variables at one time. There are limits to human and financial resources and the dead lines he can meet. By their nature some variables are harder to study than to neutralize, while others are as easily studied as neutralized. In dealing with practical considerations, the researcher must ask question like the following:

How difficult is it to make a variable a moderator as opposed to a control variable? What kinds of resources are available and what kinds are required to create moderator variables?

This is highly significant one. In educational experiment researchers often have less control over the situation than design and the related considerations might necessitate.

Operation Definitions

Immediately upon completion of the testable hypotheses a researcher should examine them and the problem in general to determine if there are any terms which may be abstract or misleading. 'If an are found particularly in the testing hypotheses, they should be defined to make them completely operational for the study being undertaken.

The necessity for operational definitions does not mean that the researcher can define a term to mean whatever he cares to make it mean, but does enable the researcher to limit the meaning of a word. Operational definition should be more specific than those used in ordinary discourse. In other words any special term which must be used in the statement of the problem may require an operational definition to ensure clarity. Particular clarification should be given terms which are used in the formulation of testable hypothesis. The term selected must be useful and make sense. Even common adjectives may be used if you adequately explain what you mean. A point to remember is that once a researcher makes a definition, he must stick to it.

Words which may need defining are those which appear ambiguous, which have confusing interpretation and which might make a difference to a person attempting to replicate the study.

The Conditions for Making Final Decision

H.H. McAshan suggests that new researcher check the following conditions for operationally defining words before making a final decision:

1. The definition decides upon must withstand subjective analysis to determine if other qualified people could look at the word involved and come to the same conclusion.
2. The reliability of each word should be checked to find out if the subjective judgements are consistent.
3. The meaning of the operationally defined words must be mutually exclusive and not synonymous with other words, terms or, expressions.
4. The definition of each word chosen must fit the material researchers intend to study.
5. The definition decides upon must include all situations of use which will be included in the course of the investigation.

An operational definition is a definition based on the observable characteristics of that which is being defined. The word 'observable' in the significant word in describing an operational definition.

There are three approaches to constructing operational definitions:

- (i) Type A,
- (ii) Type B, and
- (iii) Type C.

Type 'A' Operational Definition: The 'Type A' operational definition can be constructed in terms of the operations that must be performed to cause the phenomenon or state than an object or thing. It tells what manipulation to use to induce a particular state. They are useful in defining independent variables as prescriptions carried out by the experimenter. The same variable, of course, be operationally defined by more than one type of definition but when what variable is the independent variable. It is often the most useful.

‘Type B’ Operational Definition: The ‘Type B’ operational definition can be constructed in terms of how the particular object or thing being defined operates, that is, what it does or what constitutes its dynamic properties. ‘Type B’ operational definitions see particularly appropriate in an educational context for describing a type of person.

Though they may be used to define other variables, Type B definitions are particularly useful for defining the dependent variable when it is to be operationally based on behaviour.

‘Type C’ Operational Definitions: The ‘Type C’ operational definition can be constructed in terms of what the object or phenomenon being defined looks like, that is, what constitute its static properties. An Intelligent student can be defined as a person who has good memory, a large vocabulary, good reasoning ability, good arithmetic, skills etc. This type of operational definitions utilize observable structural properties of the object. It describes the qualities, traits, or characteristics of people or thing. Thus, they may be used for defining any type of variable when used for defining a person’s characteristics, they specify the static or internal qualities rather than his behaviour as does the ‘Type B’ definition. ‘Type C’ operational definitions often lend themselves to measurement by tests although the ability to be tested is in requisite part of the definition.

The test ability if any hypothesis depends on whether suitable operational definitions can be constructed for its variables.

ROLE OF HYPOTHESIS

The hypothesis is the basis of a scientific investigation education. It is the pivot of the research process. All the research activities are oriented towards the verification of the hypotheses.

Apart from this role it has a significant role in the formulation of theory, principles and laws. It is also known as tentative theory, after verification it takes the shape of final theory. A theory embers new hypotheses, these are subjected to verification, after the verification it becomes a new theory in field studies. In building up the theories, this cyclic process continues. It has been illustrated with the help of a diagram.

SOURCES OF HYPOTHESES

Hypotheses are originated from essentially the same background that serves to reveal problem. These sources are namely theoretical background, knowledge, insight and imagination that comes from instructional programme and wide reading experiences, familiarity with existing practices. The major sources of hypotheses are given below:

1. Specialization of an educational field.
2. Programme of reading: Pubished studies, abstracts reearch journals. Hand books, seminars on the issue, current trends on the research area.
3. Instructional programmes persuaded.
4. Analyse of the area studied.
5. Considering existing practices and needs.
6. Extension of the investigation.
7. Offshoots of research studies in the field.