
UNIT 11 HYPOTHESIS: NATURE OF FORMULATION

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11.1 INTRODUCTION

Once the selection and definition of the research problem have been accomplished, the derivation of the hypothesis is the next most important step in the research process.

From the research scholar's point of view, the hypothesis may be conveniently considered as a tentative or working assumption, and the theory as surviving or final hypothesis, which is most defensibly supported by all evidences. Hypothesis is generally derived after the selection and definition of the problem. But since the knowledge arrived through scientific method is objective in the light of new data, a theory is in only one sense a working assumption, so that the conventional distinction between hypothesis and theory, on the basis of increasing adequacy of evidence and hence greater certainty, is a only relative .

This unit describes the nature, importance and formulation of hypothesis. It also deals with various ways of stating a hypothesis and explains how it can be tested.

Various sources of hypothesis along with the characteristics and significance of hypothesis have also been explained.

11.2 OBJECTIVES

After going through this unit, you will be able to:

- define hypothesis;
- list the sources which are helpful in hypothesis formulation;
- differentiate between various types of hypotheses;
- discuss various methods to test hypotheses; and
- describe the significance of hypothesis.

11.3 MEANING OF THE HYPOTHESIS

As soon as a research question is formulated, it makes the hypothesis formulation imperative since it is a tentative solution or an intelligent guess about a research question under study. It is an assumption or proposition whose tenability is to be tested on the basis of its implications with empirical evidence and with the previous knowledge. Modern investigators agree that, whenever possible, the research should proceed from a hypothesis. In the words of Van Dalen (1973) 'A hypothesis serves as a powerful beacon that lights the way for the research worker.

Etymologically, hypothesis is made up of two words 'hypo' (less than) and 'thesis', which means less than a thesis. It is the presumptive statement of a proposition or a reasonable guess, based upon the available evidences, which the researcher seeks to prove through his/ her study. Hypothesis is an assumption or proposition whose testability is to be tested on the basis of the compatibility of its implications with empirical evidence with previous knowledge (Mouly, 1963). It is also a declarative statement in which the investigator makes a prediction or a conjecture about the outcome of the relationship. The conjecture or the prediction is not simply an "educated guess"; rather it is typically based on past researches, which investigators gathered as evidences to advance the hypothesized relationship between variables. In the formulation of hypothesis, the investigator looks for the statements where she/he relates one or more variables to make predictions about the relationships. The hypothesis tells the researcher what to do and why to do in the context of the problem.

For example, the researcher is interested to study a problem 'Why does a gifted child becomes a poor achiever in his class'? The researcher then, moves towards finding out the causes and factors that have been responsible for his poor achievement. He makes a conjecture that he might be suffering with some disease at the time of the examination. Conjecture is in the form of a hypothesis and this now determines what the researcher should do to verify whether it is a fact or not. He shall go to the house of the student, meet his parents and enquire about student's health. All that which investigator is doing is by the hypothesis he had developed.

Hypothesis thus, refers to conjecture statement about the solution of a problem, which the researcher goes on to verify on the basis of the relevant information collected by him. It is said to be a hunch, shrewd guess or supposition about what may be the answer to a problem. It is a statement which is tested in terms of the relationship or prediction etc., which after testing is either accepted or rejected.

The terms hypothesis, theory or conclusion occur frequently in research literature, but differ slightly from each other. 'Hypothesis' is defined as a tentative solution or working proposition suggested as a solution to problem, and the 'theory' as the final hypothesis, which is defensibly supported by all evidence. The final hypothesis, which fits all the evidences, becomes the chief 'conclusion' inferred from the study (Hilly, 1964). The hypothesis relates theory to observation and vice-versa. Hypotheses when tested are either rejected or accepted, and help to infer the conclusion, which helps in theory building.

11.4 SOURCES OF HYPOTHESIS

The formulation of a good hypothesis is a difficult task. The value of research is determined by the results/ conclusions arrived at after testing the hypothesis. It requires a researcher to be speculative, imaginative having good knowledge, deep insight and an analytical mind. The sources that are available with a researcher for deriving a tenable hypothesis are as follows:

11.4.1 Experience and Creativity of the Researcher

Both creativity and experience are capable of deriving adequate hypothesis. While working in an environment, a researcher comes across many problems, some of which are serious enough and requires hard work to solve them.

For example, a researcher who is working on the 'Classroom Correlates of Effective Teaching' can think of a host of factors such as teacher's mastery over the subject, effective use of teaching skills, decision-making, capability, perception of his competence, perception of student's capacity for better interaction, use of communication skills etc.

A critical analysis of these factors may facilitate the task of studying the relationship among the variables. Personal experiences of the researcher as a result of his personal readings of biographies, autobiographies, newspapers, research activities, relevant literature, informal talks with friends, socio-political speeches, etc. can be the potential sources in the generation of a hypothesis.

11.4.2 Background Knowledge

It is necessary for a researcher to be thoroughly familiar with established facts, existing theories and previous researches relating to the problem. The related literature is an important source of hypothesis formulation. It sharpens the perspective of a researcher as to how to hypothesize the relationship among the variables, which aspects of relationship have been already studied and which still remain to be tested. A rich background of knowledge enables the researcher to locate the key association among the variables and to find out the missing data needed to explain a phenomenon. The researcher should have intensive knowledge in the area in which he is carrying out an investigation and should be insightful so that she/he may deduce a hypothesis inductively after making observation of behaviour noticing trends or probable relationships.

Hypothesis is the product of considerable speculation and imaginative guess work. It is based partly on known facts and explanations. In formulating hypothesis, rich experiences and profound academic background of a researcher are helpful. Significant researches have not taken place accidentally but are the result of hard work. A researcher must have a rich background knowledge which may enable him/ her to perceive relationships among the variables.

11.4.3 Versatility of Intellect

A researcher must possess a versatile intellect to understand a theory, to deduce a hypothesis from theories, to be able to spot very quickly the contributing variables in a study, to creatively imagine the output or solution to the problem and to have an adventurous and heuristic attitude, all of which depend upon the expenditure of considerable time and effort along with the persistence of the researcher. It will induce originality in the process of research. Thus, an alert mind is capable of deriving a meaningful hypothesis and rejecting a faulty hypothesis. With his versatile intellect, the researcher may restructure his experiences and deduce the hypothesis from a theory using logic.

11.4.4 Analogies

Analogies are a strong source for the formulation of hypothesis and finding out solutions to the problem. Reasoning by analogy is based on similarities and differences between two situations in which a similar or the same phenomenon or event takes place. For example, in a research problem like the ‘Studying the Causes of Burn out Tendencies among College Students’, the researcher insightfully thinks, “Why were burn out tendencies not found among college students 20-30 years back as they are today?, What has changed them: quality of teaching or quality of leadership?” Arguing analogically in this way may lead the investigator to some conclusions which may be used for identifying variables and relationships, which form the basis of hypothesis construction. If a researcher knows from previous experience that the old situation is related to other factors Y and Z as well as to X, he may reason out that the new situation may also be related to Y and Z.

11.4.5 Scientific Theories

A systematic review and analysis of theories developed in field of psychology, sociology, political science and even in biological sciences may help the researcher to provide a suggestive base to formulate a hypothesis. For example, a researcher working on ‘Modification of Teacher Behaviour’ may be benefited by the Skinnerian theory of behaviour shaping.

11.4.6 Authentic Knowledge

Since the hypothesis offers a solution to the problem, it must be formulated in consonance with authentic knowledge and irrefutable analysis available. If the hypothesized relationship among the variables involved is substantiated, then the researcher proceeds in a meaningful and scientific manner. The analysis and interpretations provide a sound base to deduce the hypothesis. For example, if researcher is working on motivation, then Maslow’s Hierarchy of Needs will provide an authentic source for hypothesis formulation.

Check Your Progress

- Notes:** a) Space is given below for writing your answers.
b) Compare your answers with those given at the end of the unit.

1. What is the meaning of hypothesis?

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2. List various sources of hypothesis.

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11.5 TYPES OF HYPOTHESIS

11.5.1 Directional and Non-directional

A research hypothesis must be stated in a testable form for its proper evaluation. This form should indicate a relationship between the variables in clear, concise, and understandable language. Research hypotheses are as being directional or non-directional. The hypotheses which stipulate the direction of the expected differences or relationships are termed as directional hypotheses. For example, “There is positive relationship between the academic achievement and study habit of students” is a directional hypothesis. This hypothesis stipulates that students with good study habits will have high academic achievement. Similarly, the hypothesis: “Students with high test anxiety will score badly in examinations as compared to students with low anxiety” is a directional research hypothesis because it stipulates the direction of the difference between the groups.

A research hypothesis, which does not specify the direction of expected differences or relationships, is a non-directional research hypothesis. For example, the hypothesis: “There is a difference in the academic achievement of B.Ed. students enrolled in open and conventional universities” is a non-directional research hypothesis. Although the hypothesis stipulate that there is a difference in the academic achievement, the direction of the difference is not specified.

A hypothesis can take either the ‘declarative’ form, the ‘null form’ or the ‘question form.

When the researcher makes a positive statement about the outcome of the study, the hypothesis takes the declarative form. It is more or less a directional hypothesis. For example, the hypothesis: “The attitude of parents in the rural areas towards co-education at the primary level is significantly negative in comparison to the attitude of parents of urban areas” is stated in the declarative form.

In the null form, the researcher makes a statement that no relationship exists. The hypothesis: “There is no difference in the attitude of parents of rural and urban areas towards co-education at the primary level”, is an example of null hypothesis.

Null hypothesis is used to test statistically the research hypothesis, which has been stated in directional or non-directional form. Null hypothesis is also called ‘testing hypothesis’ when a directional (declarative) or non-directional hypothesis is tested statistically by converting it into null form. A null hypothesis challenges the assertion of a declarative hypothesis.

In the question form hypothesis, a question is asked as to what the outcome will be, instead of stating what outcome is expected. For example, the hypothesis: “Will teaching students through mastering learning approach decrease their test anxiety?” is a question form hypothesis.

11.5.2 Research Hypothesis and Null Hypothesis

The research or scientific hypothesis is a formal affirmative statement that predicts the tentative explanation of the relationship between two or more variables. A research hypothesis describes what operations were conducted and tools were used to measure each variable. Thus, the focus of a hypothesis depends on the type of target population, how the data are collected and what measures to be used. The whole research process is built on a research hypothesis which illustrates a theory. It is a positive and general kind of a statement, for example, ‘There is a difference between the learning styles of boys and girls’. This hypothesis is also known as (H_1) or general hypothesis, empirical hypothesis, experimental or theory or substantive or operation hypothesis. This hypothesis, however, cannot be tested, proved or disproved. It constitutes the

prediction derived from a theory under test. It is also called an alternative hypothesis, as the conclusions are drawn only after accepting or rejecting null hypothesis (H_0). Siegel (1956) states that if the null hypothesis is rejected, then the alternative hypothesis (H_1) may be accepted. Thus, the alternative hypothesis is a prediction derived from a theory under test.

Whereas, the null hypothesis is a hypothesis of indicating 'no difference' or 'no relationship', it is a neutral type of hypothesis. It denies the existence of any systematic principles apart from the effect of chance. It assumes that none or zero difference exists between two population means or treatments. Null hypothesis is a statistical hypothesis, which is tested within the framework of the probability theory. The alternative hypothesis is an operational statement of research hypothesis. The research hypothesis is the prediction derived from the theory under test. By rejecting or accepting null hypothesis, one arrives at the conclusions about the research hypothesis.

Thus, the relationship between research hypothesis (H_1) and the null hypothesis (H_0) is that, if null hypothesis (H_0) is rejected then research hypothesis (H_1) is accepted. But in the beginning stage, the researcher makes an affirmative statement, as a prediction of solution that she/he proposes to test later. At the stage of statistical analysis of data, the research hypothesis is converted into null hypothesis. All statistical tests are the tests for null hypothesis. Rejecting or accepting null hypothesis asserts that observed difference or relationship may result from chance errors due to sampling procedure.

11.6 TESTING OF THE HYPOTHESIS

After the hypotheses are stated the researcher moves towards testing them. Hypotheses are subjected to empirical as well as logical testing. The nature of a hypothesis may be simple or complex. A simple hypothesis is tested directly but a complex hypothesis cannot be tested directly. It may be tested in terms of its deduced consequences. In order to test the hypothesis in terms of deduced consequences, it is necessary to collect evidence by selecting or developing data collecting tools to analyse the data collection, and then to interpret results in the light of hypothesis and its deduced consequences. The necessary conditions for confirmation are:

- (i) all factual evidences collected through tests or other means (tools) should correspond with the deduced consequences;
- (ii) the data-collecting tools should take into account all factors and conditions that are suggested by the consequences;
- (iii) the consequences are logically deduced from the hypothesis.

Suppose the researcher wants to test the hypothesis: 'effective college principals will have higher level of job satisfaction'. This hypothesis cannot be tested directly by the researcher. He has to proceed indirectly by deducing the consequences that ineffective college principals will have low level of job satisfaction as compared to that of effective principals. In this way the researcher does not test the hypothesis, but tests the deduced consequences of the hypothesis. Once all the deduced consequences after testing come out to be true, the hypothesis is confirmed. If some of the consequences are true and some others are not, the hypothesis needs to be examined afresh (Koul, 1997, P.81).

The inference drawn as a result of testing the hypothesis is always tentative. The null hypothesis asserts that there is no difference between the means but some difference may always occur by chance, hence when the obtained difference is greater, the null hypothesis cannot be accepted. The question arises as to how much can be the difference due to change, an estimate of which is provided by the values given in statistical tables. If the obtained difference is greater than the table value, the null hypothesis is rejected. It is accepted if the obtained difference is found to have sufficiently small probability of occurrence. In either rejection or acceptance of null hypothesis, two types of

errors are always involved. These are type I and type II errors, they are also called alpha or beta errors respectively. These two errors are so related that if efforts are made to minimize one error then chances of other errors increase.

In case of historical research, by using external or internal criticism, a hypothesis is never proved; it is merely sustained or rejected. Although hypotheses are not always explicitly stated in historical researches, they are usually implied. The historian gathers evidence and carefully evaluates its trustworthiness. If the evidence is compatible with the consequences of the hypothesis, it is confirmed. If the evidence is not compatible, or negative, the hypothesis is not confirmed. It is through such synthesis that historical generalization are established (Best and Kahn, 1992, P. 64).

11.7 CHARACTERISTICS OF A GOOD HYPOTHESIS

It is essential that a hypothesis is carefully formulated. A good hypothesis has several basic characteristics:

- i) It must be testable. If a hypothesis is not testable, then it becomes difficult for a researcher to either confirm or contradict the relationship among the variables or the deduced consequences. For example, 'Education brings all round development' is difficult to test because it is not easy to operationally isolate the other factors that might contribute towards all round development.

Since, a hypothesis predicts the outcome of a study it must relate variables that are capable of being measured. The hypothesis stated as 'There is a positive relationship between the learning style and academic achievement of 8th grade students' can be tested because the variables in the hypothesis are operationally defined and therefore can be measured.

- ii) It must state the expected relationship between the variables.

For example the hypothesis: 'There is a significant effect of frustration on the academic achievement of 10th grade students' states the expected relationship between frustration and achievement, which can be measured. However, the hypothesis: 'Students who participate in N.S.S. activities show higher degree of moral growth than those who do not participate in N.S.S. activities', is not a good hypothesis as the term 'moral growth' does not refer to a variable that is measurable.

- iii) It must suggest a tentative solution to the problem under study.

For example, 'Academic achievement varies according to the level of intelligence.' This hypothesis suggests that intelligence influences the academic achievement.

- iv) It must be clear and stated in a precise manner. A clear statement of hypothesis generally involves concise technical language and definition of terms that are better defined than those in common language. Vague terms or constructs are difficult to define operationally. Use of general terms and words such as good, bad, poor, personality, social class etc make a hypothesis vague. The researcher should use 'personality' as measured by 16 PF (16 personality factors), 'Intelligence' as measured by Raven's Progressive Matrices (intelligence test) etc. in the statement of a hypothesis.

- v) The hypothesis should be limited in scope. The hypothesis of global significance may not yield the usual consequences. Sometimes an over-ambitious researcher formulates an ambiguous hypothesis of global significance. It is partly because of his earnestness and partly because it takes maturity of view point to realize how little can be accomplished in a specified time. It is desirable to formulate hypotheses that are simple to test, and yet are highly significant.

- vi) A hypothesis must be consistent with known facts. It must be consistent with a substantial body of established facts. A good hypothesis is grounded in well established theories and laws.

- vii) A hypothesis must explain what it intends to explain.
- iv) The variables should be defined operationally so that the predicted relations among them can be tested empirically. A good hypothesis is capable of explaining and testing significantly large number of consequences.
- viii) It must be based on some relevant theory or discovered truth.

For example the hypothesis, 'There is a significant relationship between the contingencies of reinforcement and behaviour shaping', derives its source from the theory of Skinner. The relationship between independent and dependent variables in this hypothesis is supported by the behaviouristic view of learning by Skinner.

- ix) The hypothesis should be amenable to testing within a reasonable time. The researcher should not select a problem which involves hypotheses that are not amenable to testing within a reasonable and specified time. The researcher must know the problems which cannot be solved for a long time because of the lack of data, non availability of tools and techniques.

11.8 SIGNIFICANCE AND IMPORTANCE OF A HYPOTHESIS

- i) A hypothesis directs, monitors and controls the research efforts. It provides tentative explanations of facts and phenomena and can be tested and validated. Such explanations, if held valid, lead to generalizations, which help significantly in understanding a problem, and thereby extend the existing knowledge in the area to which they pertain and thus help in theory building and facilitate extension of knowledge in an area.
- ii) The hypothesis not only indicates what to look for in an investigation but how to select a sample, choose a design of research, how to collect data and how to interpret the results to draw valid conclusions.
- iii) The hypothesis orients the researcher to be more sensitive to certain relevant aspects of problem so as to focus on specific issues and pertinent facts. It helps the researcher to delimit his study in scope so that it does not become broad and unwieldy.
- iv) The hypothesis provides the researcher with rational statements, consisting of elements expressed in a logical order of relationships, which seek to describe or to explain conditions or events that have not yet been confirmed by facts. Some relationships between elements or variables in hypotheses are known facts and others transcend the known facts to give reasonable explanations for known conditions. The hypothesis helps the researcher relate logically known facts to intelligent guesses about unknown conditions. (Ary, et. al 1972, pp. 73-74)
- v) Hypothesis formulation and its testing add a scientific rigour to all type of researches. A well thought set of hypothesis places a clear and specific goal before the researcher and equips him with understanding. It provides the basis for reporting the conclusions of the study on the basis of these conclusions. The researcher can make the research report interesting and meaningful to the reader.

The importance of a hypothesis is generally recognized more in the studies which aim to make predictions about some outcome. In an experimental study, the researcher is interested in making prediction about the expected outcomes and, therefore the role of hypothesis is considered to be of utmost importance. In historical or descriptive studies, on the other hand, the researcher is investigating the history of an event, life of a man, or is seeking facts to determine the status quo of some situation and thus may not have a basis for making a prediction of results. In such studies when fact finding alone is the aim of the study, a hypothesis may not be required.

Most historical or descriptive studies, however, involve not only fact-finding but interpretation of facts to draw generalizations. For all such major studies, a hypothesis is recommended so as to explain observed facts, conditions, or behaviour and to serve as a guide in the research process. If a hypothesis is not formulated, a researcher may waste time and energy in gathering extensive empirical data and then find that he can not state facts clearly and detect relevant relationships between variables as there is no hypothesis to guide her/him.

Check Your Progress

Notes: a) Space is given below for writing your answers.

b) Compare your answers with those given at the end of the unit.

3. List the characteristics of a good (usable) hypothesis.

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4. How is hypothesis tested?

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11.9 LET US SUM UP

Hypothesis is tentative solution or an intelligent guess about a research problem under study. It is not simply an educated guess, rather it is based on past research where the researcher gathers the evidence to advance a hypothesized relationship between variables. Thus, it is a conjecture statement about the solution of a problem, which the researcher goes on to verify on the basis of relevant information. Various sources, namely, experience, creativity, background knowledge, scientific theories etc. are important sources, which are important sources which are helpful in the formulation of a hypothesis.

Based on these sources, hypotheses are of various types: i) Directional and non-directional, and ii) Research and null hypothesis.

After the hypothesis is formulated, it is subjected to testing. Some hypotheses are simple and can be tested directly. In most situations, however, they are complex and can not be so tested. They are tested in terms of their deduced consequences.

A good hypothesis is one which is testable, and states the expected relationship between variables. It is clearly and precisely stated. A good hypothesis should state the expected relationship between the variables. It is limited in scope and should be consistent with the most known facts.

A hypothesis has great significance in the research process. It (i) directs, monitors and controls the research effort, (ii) helps in drawing generalizations to build theories, (iii) suggests the method of problem solving, (iv) helps in studying cause-effect relationship between the variables, (v) facilitates extension of knowledge in an area, and (vi) provides a basis for reporting the conclusions of the study.

11.10 UNIT-END ACTIVITY

- Refer to any five M.Ed. or M.A. (Education) dissertations. Find out the nature of hypotheses used in the dissertations.

11.11 POINTS FOR DISCUSSION

1. Discuss the importance of hypothesis in experimental studies.
2. Discuss the nature of hypothesis in Survey and Experimental Research.

11.12 SUGGESTED READINGS

- Ary, D., Lucy C. Jacobs, and Asghar Razavieh (1972): *Introduction to Research in Education*. New York: Holt, Rinehart and Winston, Inc.
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- Van Dalen, V. (1973): *Understanding Educational Research*. New York: McGraw Hill Book.
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11.12 ANSWERS TO CHECK YOUR PROGRESS

1. Hypothesis is the presumptive statement of a proposition or a reasonable guess, based upon the available evidence, which the researcher seeks to prove through his study.
2. Experience, background knowledge, versatility of intellect and analogies, scientific theories are importance sources which help in the hypothesis formulation.
3. A good hypothesis should (i) be clearly and precisely stated; (ii) be testable; (iii) state the expected relationship between variables; (iv) be limited in scope; and (v) be consistent with most known facts.
4. Hypothesis is subjected to empirical and logical testing. The nature of the hypothesis can be tested directly. A complex hypothesis is tested in terms of its deduced consequences. The process involved is to collect evidence by selecting or developing data collecting tools, to analyse data, and then to interpret results in the light of hypothesis and its deduced consequences.