'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

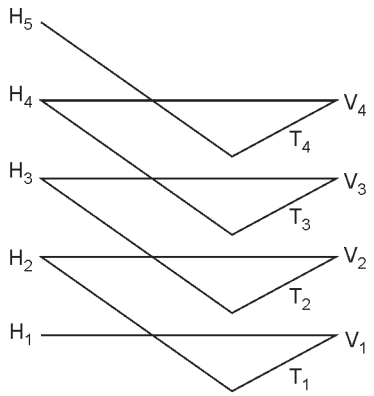
The hypothesis is the basis of a scientific investigation education. It is the pivot of the research process. All the research activities are oriented towards the verification of the hypotheses.

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 pursuaded.
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.



H = Hypothesis, V = Verification
T = Theory Process for the Formulation of Theories

Process for the Formulation of Theories

Researcher employs these sources for formulating hypotheses of his investigation. He has to use two logical processes to drawn upon in developing a hypothesis. The processes are known as:

(*a*) Deductive thinking, and

(*b*) Inductive thinking.

(*a*) Deduction is a process which goes from the general to the specific : When general expectations about problems or events based on presumed relationships between variables are used to arrive at more specific expectations, that process is called deduction.

(*b*) Induction is a process which goes from the specific to the general: In the induction process researcher starts with specific observations and combines them to produce a more general statement of relationship namely a hypothesis. Many researchers begin by searching the literature for relevant specific findings in order to induce a hypothesis, and other often run a series of exploratory studies before attempting to induce a hypothesis.

Induction begins with data' and observations or empirical events and proceeds toward hypothesis and theories, while deduction begins with theories and general hypothesis and proceeds towards specific hypothesis.

FORMULATING HYPOTHESIS

From any problem statement, it is generally possible to derive more than one hypothesis. There are three simple hypotheses generated from this problem to determine, "the effect of " massive, positive, verbal rewards on the reading achievement of children."

At first glance these three hypotheses might be offered :

(A) Reward Increases reading achievement.

(B) Reward decreases reading achievement.

(C) Reward has no effect on reading achievement.

Evidence has already been obtained in the laboratory to support the hypothesis (A) rewards increase performance. However, upon closer examination, the primary purpose of this study is to

determine whether the enhancing effect of rewards can be incorporated into a class-room setting to facilitate children's learning to read. This theory is based on the assumption that the 'law' of learning should apply in classroom. If perhaps more subtly than in a laboratory and on the laboratory findings that support the assumed relationship between reward and performance, the logical conclusion would be that rewards would have a demonstrable enhancing effect on classroom performance. This conclusion is based on the first assumption arrived at deductively and the second arrived at inductively.

Both induction and deduction. are needed to choose among the possibilities. Many theories, both psychological and educational deal with stabilization (and rigidifying) of behaviour patterns as a function of their use.

Researchers formulate hypotheses using induction and deduction, one of the goals of researcher is to produce that pieces for generalizable bodies of theory which will provide answers to practical problems. Hypothesis construction and testing enable researchers to generalize their findings beyond the specific conditions which they were obtained.

Since a hypothesis is a formulation of anticipated findings, students are advised to develop a hypothesis as a means of demonstrating the basis for their study to themselves and their reader. The task of introducing a study and discussing the findings are facilitated by existence of a hypothesis.

FORMULATION OF TESTABLE HYPOTHESIS

A hypothesis is a tentative assumption drawn from knowledge and theory which is used as a guide in the investigation of other facts and theory that are as yet unknown. The hypothesis formulation is one of the most difficult and most difficult step in the entire scientific process. A poorly chosen or poorly worded hypothesis can prevent:

(*a*) the obtaining of enough pertinent data,

(*b*) the drawing of conclusions and generalizations, and

(*c*) the application of certain statistical measures in the analysis of the result.

It is impossible to over-emphasize the role of the hypothesis in research. It is the central core of study that directs the selection of the data to be gathered, the experimental design, the statistical analysis, and the conclusions drawn from the study.

A study may be devoted to the testing of one major hypothesis, a number of subsidiary hypotheses, or both major and subsidiary hypotheses. When several hypotheses are used, each should be stated separately in order to anticipate the type of analysis required and in order to definitely accept or reject each hypothesis on its own merit. Regardless of the number or type of hypotheses used, it is extremely important that each be specific testable, and based upon a logical foundation. Hildreth Hoke McAshan says only one possible exception to the above statements, which is that when fact finding alone is the primary aim of the study, it may not always be necessary to formulate an explicit hypothesis. However, this need not be a concern of most scientific researchers.

FUNDAMENTAL BASES OF HYPOTHESIS

The researcher deals with reality on two levels,

(*a*) The operational level, and

(*b*) Conceptual level.

On the operational level researcher must define events in observable terms in order to operate with the reality necessary to do researches.

On the conceptual level he must define events in terms of underlying communality (usually causal) with other events. Defining at a conceptual level, the researcher can abstract from single specific instance to general dues and thus, begin to understand how phenomena operate and variables interrelate. The formulation of an hypothesis very frequently requires going from the operational or concrete level to the conceptual or abstract level. It is this movement to the conceptual level which enables that the result to be generalized beyond the specific conditions of a particular study and thus to be of wider applicability.

Research requires the ability to move from the operational to the conceptual level and vice-versa. This ability is required not only in constructing experiments but in applying their findings as well.

Consider a hypothetical study in which programmed instruction is being compared to traditional instruction. The term 'Programmed Instruction" and "Traditional Instruction" are operational terms. These operational terms should be examined for underlying conceptual similarities and differences. This process of making conceptual contrasts between operational programme is called conceptualization or dimentionalization.

Dimensions useful for contrasting programmed and traditional instruction might be degree of feedback, rate of positive reinforcement, uniqueness of presentation format, control of pacing size of instructional units and degree of incorporation of student performance feedback in instructional design.

These six dimensions or concepts could be used for classifying any instructional model as a basis for understanding its relation to other models.

Such classification at this abstract level would help one not only hypothesize whether instructional 'model A' will be more effective than 'model B' on certain specific criteria, but to begin to understand why 'model B' is better and thus to be able to build 'model A' into other instructional procedures.

Moving from the operational to the conceptual level and vice-versa is a critical ingredient of the research to demonstration process.

Difficulties in the Formation of Useful Hypothesis: The following are the difficulties in the formation of hypothesis:

1. Absence of knowledge of a clear theoretical framework.
2. Lack of ability to make use of the theoretical framework logically.
3. Lack of acquaintance with available research technique resulting in failure to be able to phrase the hypothesis properly.

Testing the Hypothesis

The evidence of the work of hypothesis lies in its abilities to meet test of its validity. The purpose of testing a hypothesis is to determine the probability that it is supported by fact. Because a hypothesis is a general expectation about the relationship between variables there is an extremely large number of instances under which it can be tested, and it would be impractical to attempt to gain support in all of these instances. Validity of a hypothesis is established in two stages:

1. The statement of hypothesis allows the investigator to develop deduction and certain implications which when stated in operational terms can lead to rejection of hypothesis that are in conflict with accepted knowledge at the logical level.

   For example a hypothesis which says, for instance, that nondirective teachers are more effective than directive teachers would have to be tested for many groups of teachers, in

many subjects and many settings, and with many criteria before it could be accepted. If, on the basis of limited testing the hypothesis fails to yield confirming results, then it would be fair to reject it.

2. If a hypothesis passes the test of logic, it then must be subjected to an empirical test, perhaps through an experiment or a series of measurement. The hypothesis that boys are stronger or taller than girls, for example, can be verified through measurements.

A hypothesis is never proved it is merely sustained or rejected. If it fails to meet the test of its validity, it must be modified or rejected.

The confirmation of a hypothesis, on the other hand, is always, tentative and relative, subject to later revision and even rejection as further evidence appears or as more adequate hypotheses are introduced.

The form of the hypotheses to be tested can be very controversial. The null form' is probably preferred by most experienced research personnel. The null hypothesis states that there is no difference between two groups or treatments. It is generally used to spell out what would be the case if the null hypotheses were true. The no difference statement assumes that the two groups will be tested and found to be equal.

FORMAL CONDITIONS FOR TESTING HYPOTHESES

There are two types of hypothesis statements:

(*a*) Null hypothesis, and

(*b*) Hypothesis prediction form.

Whether the experimenter chooses the hypothesis prediction or the null form, there are certain formal conditions which must be met in order for the hypothesis to be considered testable. These are listed below:

1. It must be stated so that deductions can be made from it and so that decisions can be reached as to whether or not it explains the facts being considered.
2. It should be worded clearly and unequivocally in operational terms. This should leave no doubt as to what action, what prediction, what quality or quantity, or who is involved ?
3. It must be capable of being refuted. There must be some comparisons possible which will allow the researcher to give either a 'yes' or 'no' answer to the hypothesis stated.
4. It should be specific and testable, with all predictions and operations to be tested spelled out.
5. It should have simplicity. If it is too complex, consideration should be given to dividing it into sub-hypothesis.
6. It should be directly related to the empirical phenomena.
7. It must be stated in final form early in the experiment before any attempt at verification is made.
8. It should be so designed that its test will provide an answer to the original problem which forms the primary purpose of the investigation.
9. It must be related to available techniques of design procedure, and statistical analysis.
10. It should be related to available knowledge or theory concerning the original problem area.

The statement of the problem, review of literature, and other planning of early stages of a project are largely performed so as to enable the researcher to arrive at good, clearly stated, testable hypothesis.

CRITERIA FOR EVALUATING HYPOTHESIS

Some hypotheses are considered more satisfactory than others. The following are the serious considerations of a satisfactory hypothesis and these criteria may be helpful to make this judgement.

1. **Plausibility of Explanation:** Several criteria are involved in establishing the plausibility of explanations. A satisfactory hypothesis should have relevant and logical possibility about the relationship of variables included in them.
2. **Testability of Explanation:** The variables should be defined operationally and the predicted relations among them can be tested empirically. The variables of the hypothesis should be measurable or quantifiable. The suitable measuring instrument is available or it can be considered easily.
3. **Adequacy of Scope:** The most useful hypotheses explain all the facts that are relevant to the phenomena being explained and contradict none of them. The broader the scope of a theory, the more valuable it is. The more consequences that a hypothesis yields, the greater is its fruitfulness.

   A hypothesis is of greater value if it establishes a generalization that can be applied in many areas of education or in many fields.

   The most satisfactory hypotheses not only explain all the known facts that gave rise to the original problems but also enable scientists to make predictions about as yet unobserved events and relationships.
4. **Usefulness of False Hypotheses:** Hypotheses need not be the correct answers to problems to be useful. In almost every inquiry a scholar formulates several hypotheses and hopes that one will provide a satisfactory solution to the problem. By eliminating the false hypotheses one by one the investigator keeps narrowing the field in which the answer must lie. The testing of false hypotheses is also of value if it directs the attention of scientists to unsuspected facts or relations they eventually help in solving the problem.
5. **Roots in Existing Theories:** A useful educational hypothesis, therefore, adds something to previously established knowledge by supporting, qualifying, refuting or enlarging upon existing theories. A hypothesis that is compatible with well-attested theories is in a favourable position to advance knowledge. If progress is to be made new hypotheses must fit into the framework of existing theories and transform them into more perfect explanatory schemes. Thus, even the more revolutionary theories are not completely different from the existing edifice of knowledge.
6. **Suitability for Intended Purpose:** Each hypothesis that offers a satisfactory explanation of what it intends to explain is useful for that purpose. Every hypothesis serves a specific purpose and must be adequate for the purpose it claims to serve. Thus, suitability is also the important criterion for an effective hypothesis.
7. **Simplicity of Explanation:** If two hypotheses are capable to explain the same facts, the simpler one is the better hypothesis. Simplicity means that the hypothesis explains the phenomena with the least complexes theoretical structure. The hypothesis that accounts for all facts with the fewest independent or special assumptions and complexities is always preferable.

8. **Levels of Explanation:** The value of hypothesis can best be comprehended by tracing their relationship to facts theories and laws. The scientists build gradually a hierarchy of knowledge consisting of (1) hypotheses (2) theories and (3) laws. The following discussion will distinguish among these levels of knowledge.
   (*a*) *Hypotheses and Facts*: A hypothesis is the first step in the direction of scientific truth. In the hierarchy of scientific knowledge it is the lowest on the scale. If empirical evidence can be found to verify the hypothesis, it gains the status of a fact. Thus, a fact is the verified hypothesis.
   (*b*) *Hypotheses and Theories*: A theory may contain several logically interrelated hypotheses and postulates may be used as a synonyms for hypotheses. Hypotheses and theories are both conceptual in nature. A theory usually provides a higher level explanation than a hypothesis. A theory presents a comprehensive conceptual scheme that may involve several related hypotheses and explain diverse phenomena, considerable empirical evidences are needed to support it.
   (*c*) *Hypotheses and Laws*: Some hypotheses receive sufficient confirmation to lead to the formulation of theories; some lead to the establishment of laws. Laws utilize highly abstract concepts, for they provide the most comprehensive type of explanations. Laws may explain phenomena that have been explained previously by two or three theories. A law retains its lofty scientific status which it claims to explain.

THE ROLE OF HYPOTHESES

The hypotheses play significant role in the scientific studies. The following are some of the important role of a hypothesis

- The purpose of stating hypothesis, like the purpose of theories that may be involved, is to provide a framework for the research procedure and methodology. It directs the research activities.
- A research project need to proceed from a statement of hypotheses. Such hypotheses are not ends in themselves but rather aids to the research process.
- A hypothesis takes on some characteristics of a theory which is usually considered as a larger set of generalization about a certain phenomenon.
- The verification. of a hypothesis does not prove or disprove it; it merely sustains or refutes the hypotheses.
- The hypotheses may imply research procedures to be used and necessary data to be organized.
- Such hypotheses are not ends in themselves but rather aids to the research process.
- The conclusions of the research problem may also be stated in the context of the initial hypotheses.
- The stating a hypotheses in experimental research provide the basis for designing the experiment and collecting evidences empirically for its verification so as to formulate new theory in field of education.
- The hypothesis orients the research process for its verification rather than finding out the solution of the problem.

OBJECTIONS AGAINST STATING HYPOTHESES

The following objections are raised against stating hypotheses which are directional in nature

- One is that hypotheses bias the researcher in favour of certain conclusions or retain the hypotheses.
- Another is that in his pursuit of the stating hypothesis the researcher may overlook other possibly worthwhile hypotheses.
- The statement of hypotheses in some situations also may appear premature.
- A directional hypothesis needs some theoretical rationale but in some situations there is very little background information about them.
- The researcher may decide to defer any hypothesis or theories until he has some empirical evidence upon which is to base them.
- The hypotheses are stated in vacuum. These should be concerned with a situation in which it can be experienced.
- The directional hypotheses should be so stated as to reveal the role of variables involved in the investigation.

The overall consensus is in favour of stating hypotheses whenever they are feasible. In view of the above objections. researchers prefer to formulate the non-directional hypotheses these days.

HYPOTHESES IN HISTORICAL RESEARCH

The historical researcher uses his information to describe and interpret conditions, events and phenomena that existed during the period under study. Some of the scholars of research methodology are of this view that the historical researcher also can formulate hypotheses to direct the research activities. These hypotheses are attempts at explaining and interpreting the phenomena of the period under the study.

There is difference between scientific hypotheses and historical hypotheses. Hypotheses in historical research are not formulated in a statistical sense or null hypothesis. Historical hypothesis takes on a broader meaning as a conjecture of the situation.

An example, a researcher is pursuing historical research on the development of teacher-education of the secondary stage in India. There would be several hypotheses. One hypothesis may be- 'The development of teacher-education as an outgrowth of secondary schools and inadequate supply of teachers produced by the colleges'. This hypothesis is based on the assumption that there has been development of teacher-education. If this assumption was not correct, the hypothesis would have no basis. The matter of basing hypotheses on accurate assumptions may seem obvious, but failure to do so is not unknown. The position of hypothesis is based on the assumption.

USES OF HYPOTHESES IN EDUCATIONAL RESEARCHES

The educational researches may be classified into four types:

1. Experimental research,
2. Normative survey research,
3. Historical research, and
4. Complex casual research.

1. Hypotheses are indispensable for experimental researches. The experiments are conducted to collect empirical data to verify hypotheses. The experimental method or experimental designs are based on hypotheses. Hypotheses are the crucial aspects of such researches.
2. In normative survey research the investigator may or may not employ hypothetical type thinking, depending upon the purpose of the research study. Hypotheses are essential for analytical studies and there is little scope in descriptive type studies.
3. In historical research the purpose may be either to produce a faithful record of the past events irrespective of present day problem or to extend the experience with phenomena in the present to past in order to make the view of the phenomena. There is a little scope of hypotheses in historical research because hypothesis has the future reference and its verification on empirical data. Case study method has no scope for constructing hypotheses because it is developmental type study.
4. In complex casual research the hypotheses have important role in such investigations. These types of studies are conceptual in nature whereas historical are more factual in nature. Therefore formulation of hypothesis is a crucial step of this type of studies.

EXERCISES

1. Define the term 'Hypothesis'. Differentiate among assumption, postulate and hypothesis.
2. Explain the nature and functions of a hypothesis in a research process.
3. Enumerate the significance and importance of hypotheses in scientific research.
4. There are various kinds of hypotheses. Mention some important hypotheses. Why researchers prefer non-directional hypotheses?
5. Hypothesis is a statement which involves a relationship of variable. Enumerate the types of variables included in stating a hypothesis.
6. Differentiate between research hypotheses and null hypotheses and illustrate your answer with suitable example.
7. Indicate the main characteristics of a good hypothesis and uses of a hypothesis in various types of research studies.
8. Enumerate the criteria for evaluating a hypothesis and role of a hypothesis.
9. "Historical researches may have hypotheses but these are different from the hypotheses of scientific researchers". Comment on this statement.