Research Methodology in Education

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Contents

Hypothesis

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All advances in scientific understanding at every level begin with a speculative adventure, an imaginative preconception of what might be true - a preconception which always and necessarily goes a little way beyond anything which we have logical or factual authority to believe in. It is the invention of a possible world, or of a tiny fraction of that world. The conjecture is then exposed to criticism to find out whether or not that imagined world is anything like the real one. A scientific reasoning is therefore at all levels an interaction between two episodes of thought- a dialogue between two voices the one imaginative and the other critical a dialogue if you like between the possible and the actual between proposal and disposal, conjecture and criticism between what might be true and what is in fact the case. (Medawar, 1972).

The word hypothesis is derived from two words namely 'hypo' and 'thesis'. Hypo means something less or little and thesis means a derived conclusion or theory. Hypothesis is a well planned hunch guess or working assumption written in the form of a declarative statement for answering a research question the truth of which is ascertained by the researcher through his research study (Mangal, 2013).

According to Simcock and Hayne, 'A hypothesis is a statement assumed to be true for the purpose of testing its validity'. A hypothesis is a researcher's prediction of the research findings, a statement of the researcher's expectations about the relations among the variables in the research topic. It is a tentative theory or supposition provisionally adopted to explain certain facts and to guide the investigation. All the hypotheses are based on theory or previous knowledge.

Hypothesis is an informed speculation, which is set up to be tested about the possible relationship between two or more variables (Bryman & Alan, 2012).

Hypothesis is an empirically testable version of a theoretical proposition that has not yet been tested or verified with empirical evidence. It is most used in deductive theorizing and can be restated as a prediction. (Neuman et al., 2012)

Hypotheses are declarative statements in quantitative research in which the investigator makes a prediction or a conjecture about the outcomes of a relationship (Creswell, 2014)

Kerlinger (1979) noted that, hypotheses are much more important in scientific research than they would appear to by knowing what they are and how they are constructed. They have a deep and highly significant purpose of taking man out of himself. Hypotheses are powerful tools for the advancement of knowledge although formulated by man, they can be tested and shown to be correct or incorrect apart from man's values and beliefs.

George A. Lumberg has defined the hypothesis is a tentative generalization, the validity of which remains to be tested. In its most elementary stage the hypothesis may be a hunch, guess, imaginative ideas, which become the basis for action or investigation.

Good and Hatt defined, 'hypothesis is a proposition which can be put into test to determine its validity'.

According to Webster, A Hypotheses are tentative explanations of a principle operating in nature.

A hypothesis defined by Verma and Beard (1981), 'a tentative proposition which is subject to verification through subsequent investigation. It may also be seen as the guide to the researcher in that it depicts and describes the method to be followed in studying the problem. In many cases hypotheses are hunches that the researcher has about the existence of relationship between the variable.

Filck, (2011) defined hypothesis as, "an assumption that is formulated for the study purposes (mostly coming from the literature or an existing theory) in order to test it empirically in the course of the study. Often formulated ad if – then statements."

Hence hypotheses make statements about relations between the variables and provide a guide to the researcher as to how the original hunch might be tested.

Hypotheses in Quantitative Studies

Hypotheses are essential to all quantitative research studies, with the possible exception of some survey studies whose purpose is to answer certain specific questions. A quantitative researcher formulates a hypothesis before conducting the study because the nature of the study is determined by the hypothesis. Every aspect of the research is affected, including participants, measuring instruments, design, procedures, data analysis, and conclusions. Hypotheses are typically derived from theories or from knowledge gained while reviewing the related literature, which often leads the researcher to expect a certain finding.

For example, studies finding white chalk to be more effective than yellow chalk in teaching mathematics may lead a researcher to expect white chalk to be more effective in teaching physics as well, if there are no other findings to the contrary. Similarly, a theory suggesting that the ability to think abstractly is quite different for 10-year-olds than for 15-year-olds may lead a researcher to propose a hypothesis that

10- and 15-year-olds perform differently on tests of abstract reasoning.(Gay et al., 2012).

Hypotheses in Qualitative Studies

Qualitative researches and Quantitative researches differ substantially in terms of their objectives, Methodology and statistical tests. No formal hypotheses are framed in qualitative researches before conducting studies. Qualitative researchers understand the nature of their participants and contexts before stating a research hypothesis. However, qualitative researchers may develop guiding hypotheses rather than testing hypotheses for the proposed research. The inductive process widely used in qualitative research is based on observing patterns and associations in the participants' natural setting without prior hunches or hypotheses about what researchers will study and observe. Thus, qualitative researchers have more discretion in determining when and how to examine or narrow a topic. Identifying patterns and associations in the setting often help a researcher discover ideas and questions that lead to new hypotheses. Qualitative research questions encompass a range of topics, but most focus on participants' understanding of meanings and social life in a particular context. However, these general topics must necessarily be more focused to become useful and researchable questions

For example, the repeated observation that early in the school year first-grade students can accurately identify the "smart" and the "not smart" students in class may suggest a hypothesis about how teachers' actions and words communicate students' status in the classroom. In simple terms, it is generally appropriate to say that strength of qualitative research is in generating hypotheses, not testing hypotheses.

Having identified a guiding hypothesis, the qualitative researcher may operationalize the hypothesis through the development of research questions that provide a focus for data collection For example, the topic "What are the cultural patterns and perspectives of this group in its natural setting?" can be narrowed by asking, "What are the cultural patterns and perspectives of teachers during lunch in the teachers' lounge?" Similarly, the topic "How do people make sense of their everyday activities to behave in socially acceptable ways?" may be narrowed by asking, "How do rival gang members engage in socially acceptable ways when interacting with each other during the school day?" (Gay et al., 2012).

Sources of Hypothesis

Hypothesis can be derived from various sources (Krishnaswami et al., 2018)

i. Theory
ii. Observation
iii. Analogies
iv. Intuition and Personal
v. Findings of studies
vi. State of Knowledge
vii. Culture
viii. Continuity of Research

Characteristics of a good research hypothesis

A hypothesis should be based on a sound rationale. It should derive from previous research or theory and its confirmation or disconfirmation should contribute to educational theory or practice. Therefore, a major characteristic of a good hypothesis is based on sound reasoning that it is consistent with theory or previous research. A number of criteria could be applied to determine the value of a hypothesis. Gay et al., (2012) formulated the following guidelines to develop a good research hypothesis.

i. A good hypothesis provides a reasonable explanation for the predicted outcome.
ii. A good hypothesis states as clearly and concisely as possible the expected relation (or difference) between variables and defines those variables in operational, measurable terms. Also it should be simple.
iii. A well-stated and well-defined hypothesis must also be testable—and it will be testable within a reasonable time frame if it is well formulated and stated.

Importance of Hypothesis

According to Goode and Hatt, 'without hypothesis the research is unfocussed, a random empirical wandering. The results cannot be stated as facts with clear meaning. It is a necessary link between theory and investigations which lead to discovery and addition to knowledge.' P.V. Young has rightly said, "The use of hypothesis prevents a blind research and indiscriminate gathering of masses of data which may later prove irrelevant to the problem under study" (Neogi, 2011).

i. Hypothesis gives point to enquiry more specific and to the point.
ii. Hypothesis helps to precede the research in a right direction.
iii. It helps in selecting relevant factors
iv. It helps in drawing specific conclusions

Nature of Hypothesis

The hypothesis is a clear statement of what is intended to be investigated. It should be specified before research is conducted and openly stated in reporting the results. This allows to -

i. Identify the research objectives
ii. Identify the key abstract concepts involved in the research
iii. Identify its relationship to both the problem statement and the literature review.
iv. It is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry
v. Hypotheses are not moral or ethical questions
vi. It is neither too specific nor to general
vii. It is a prediction of consequences
viii. It is considered valuable even if proven false

Types of Hypotheses

The three types of hypotheses are:

1. Research hypothesis
2. Statistical hypothesis
3. Substantive hypothesis

A Hypothesis can be directional or non directional. A directional hypothesis states the kind of difference or relationship between two conditions or two groups of participants. A non directional hypothesis simply predicts that there will be a difference or relationship between two conditions or two groups of participants, but it does not state the direction of the difference. (Cohen, L. et al., 2013)

1. Research hypothesis

A Research hypothesis is a statement of what the researcher believes will be the outcome of an experiment. That is before studies are undertaken, researchers often have some idea or theory based on experience or previous work as to how the study will turn out. These ideas, theories or notions established before an experimenter of study is conducted are research hypothesis.

Examples:

i. Mental health is a good indicator of academic achievement.
ii. Meta cognition and critical thinking are positively correlated.

2. Statistical hypothesis

Statistical hypothesis are those hypotheses the validity of which can be tested through statistical means (inferential statistics in the case of quantitative researches). The major weakness of a substantive or research hypothesis is that it cannot be tested with the help of statistical techniques. Statistical techniques are very much needed for the testing of the validity of a tentative solution in the form of research hypothesis and it cannot be possible unless the researcher presents his hypothesis in the form of another type of hypothesis named as statistical hypothesis. As Kaplan, A.(1964) has pointed out " all inductive inference is based on samples… All hypotheses might be said to be statistical hypothesis in a broad sense: statistics has the task of assessing the weight of evidence for a particular hypothesis contained in a given set of data"

Directional Hypothesis: The mean of the adjustment scores of the teachers of government schools in Tamilnadu is higher than the mean of the adjustment scores of the teachers of non government schools.

Non Directional hypothesis: There is a significant difference between the mean scores of adjustment of the teachers working in the government and non-government schools.

In order to prove or disprove scientifically the research hypotheses have to be converted in to statistical hypothesis and then test the statistical hypothesis using standard procedures (Black, 2012).

Null hypothesis: A hypothesis that states there is no significant effect of an independent variable on a depended variable. The null hypothesis represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved. It is denoted by H_0or H_N and pronounced as "H oh" or "H-null" .The null hypothesis represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved. It has a serious outcome if incorrect decision is made. The null hypothesis states that the null conditions exists that is there is nothing new happening, the old theory is still true , the old standard is correct and the system is in control.

There is no significant difference between the mean scores of emotional intelligence of the teachers working in the government and non government schools.

There is no significant difference between males and females in the results of the English examination.

Alternative hypothesis: A hypothesis paired with the null hypothesis that says an independent variable has a significant effect on a dependent variable. It states that the new theory is true, there are new standards, the system is out of control and or something is happening. The alternative states that there is a change/ difference/correlation between the subsamples or the variables.

There is a difference between the pretest and post test results of the students in the experimental group.

There is a statistically significant positive correlation between examination scores in Mathematics and Science.

3. Substantive hypotheses

In testing a statistical hypothesis, a researcher reaches a conclusion based on the data obtained in the study. If the null hypothesis is rejected and therefore the alternative hypothesis is accepted, it is common to say that a statistically significant result has been obtained. In addition to understanding a statistically significant result, the researchers need to determine what to them a substantive result is. A substantive result is when the outcome of a statistical study produces results that are important to the decision maker.

Testing the Hypothesis

Hypothesis testing is a procedure for making decisions about results by comparing an observed value with a population value to determine if no difference or relationship exists between the values (Creswell, J.W., 2012).The researcher selects the sample, measuring instruments, design, and procedures to collect the data necessary to test the hypothesis. During the course of a research study, those data are analyzed in a manner that permits the researcher to determine whether the hypothesis is supported. But the

analysis of the data does not lead to a hypothesis being proven or not proven, only supported or not supported for this particular study. The results of analysis indicate whether a hypothesis is supported or not supported for the particular participants, context, and instruments involved. Many beginning researchers have the misconception that if the hypothesis is not supported by the data, then the study is a failure, and conversely, if the hypothesis is supported, then the study is a success. Neither of these beliefs is true. If a hypothesis is not supported, a valuable contribution may be made through the development of new research methods or even a revision of some aspect of a theory. Such revisions can generate new or revised hypotheses and new and original studies. Thus, hypothesis testing contributes to education primarily by expanding, refining, or revising its knowledge base.

The process of testing hypotheses the statisticians and researchers use the following eight steps. (Black, 2012).

i. *Establish a null and alternative hypothesis:* In establishing the null and alternative hypotheses, it is important that the business researcher clearly identify what is being tested and whether the hypotheses are one tailed or two tailed. In hypothesis testing process, it is always assumed that the null hypothesis is true at the beginning of the study.

ii. *Determine appropriate statistical test:* In selecting test the researchers needs to consider the type, number and level of data being used in the study along with the statistic used in the analysis.

iii. *Set the value of alpha, the Type I error rate:* The common values of Alpha such as 0.05, 0.01, 0.10 and 0.001 could be set

iv. *Establish the decision rule:* Using the alpha value and the test statistic critical values can be determined. Using the critical values established, the possible statistical outcomes of a study can be divided into two groups.

   a. *The statistical outcomes that results in the rejection of the null hypothesis lie in the region called rejection region*

   b. *The statistical outcomes that fail to result in the rejection of the null hypothesis lie in the region called non rejection region.*

v. *Gather sample data:* Use suitable methods and sampling technique, relevant data was to be collected. A strong effort should be made to avoid all non-sampling errors.

vi. *Analyse the data:* After the data are sampled the test statistic can be calculated.

vii. *Reach a statistical conclusion:* Using the previously established decision rule and the value of the test statistic the researcher can draw a statistical conclusion whether the null hypothesis is rejected or is not rejected.

viii. *Make a business decisions:* Final step is to draw the implications and decide whether a statistically significant result is really a substantive result.

Testing & Challenging

The degree of challenge to the hypothesis will depend on the type of problem and its importance. It can range from just seeking "a good enough" solution to a much more rigorous challenge. The term "challenging" may include – Verification, Justification, Refutability, Validity, Rectification and Repeatability. There are two possibilities:

- Nothing happened: the Null Hypothesis - Ho
- Something happened: the Alternative Hypothesis - H1

The statistical test of a directional hypothesis gives one-tailed hypothesis test and the statistical test of a non-directional hypothesis gives two-tailed hypothesis test.

Type I Error

A Type I error occurs when the null hypothesis (H0) is rejected when it is true. The probability of committing a Type I error is called alpha or level of significance alpha equals the area under the curve that is in the rejection beyond the critical values. The value of the alpha is always set before the study.

For example, A type I error would occur if we concluded that the two drugs produced different effects when in fact there was no difference between them.

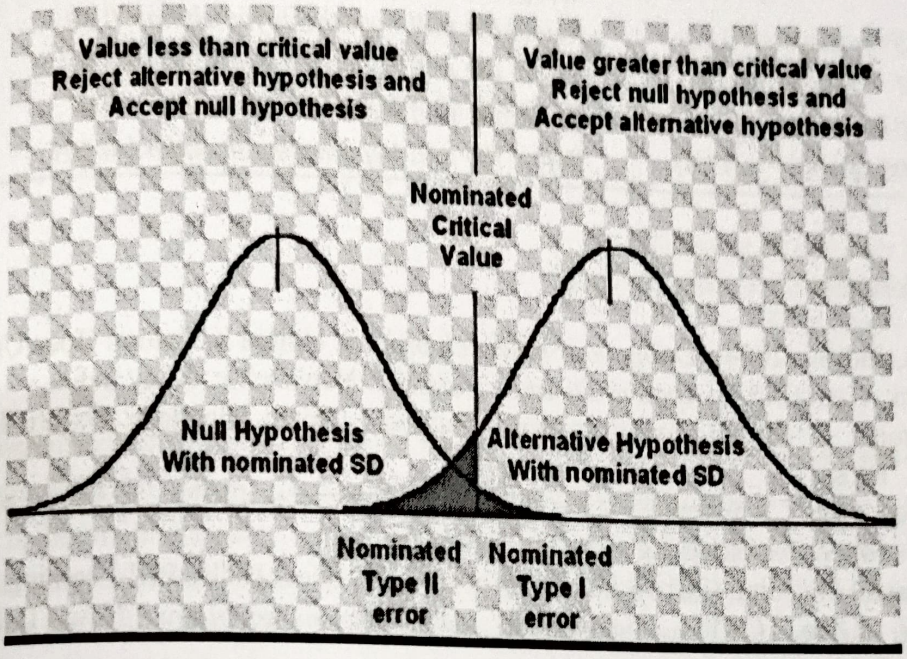
	NULL IS TRUE	***NULL IS WRONG***
REJECT null hypothesis	**TYPE I ERROR** **α**	**CORRECT**
ACCEPT null hypothesis	**CORRECT**	**TYPE II ERROR** **β**

Type II Error

A type II error occurs when the null hypothesis H0, is not rejected when it is in fact false. The probability of committing a Type II error is beta. Unlike alpha (α), beta (β) is not usually stated at the beginning of the hypothesis testing procedure.

For example: A type II error would occur if it were concluded that the two drugs produced the same effect, that is, there is no difference between the two drugs on average, when in fact they produced different ones.

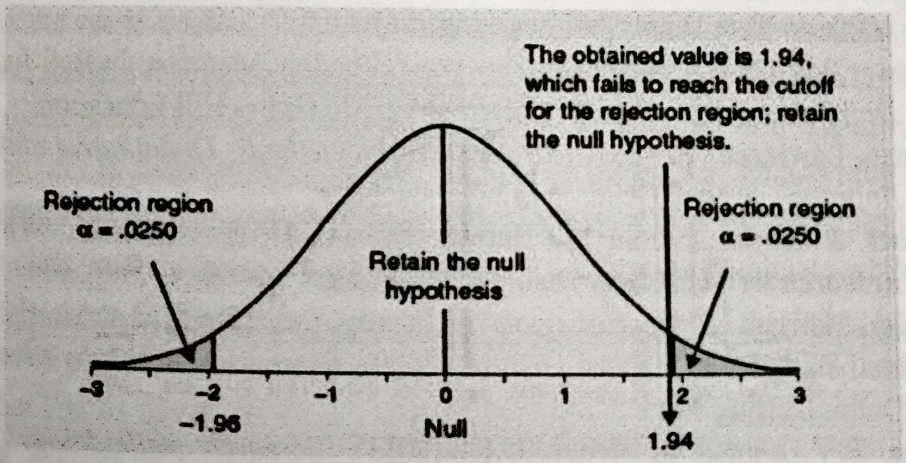
Power is equal to 1- β is the probability of a statistical test rejecting the null hypothesis when the null hypothesis is false.



Using the critical values method to test Hypothesis

Another method of testing hypothesis is the critical value method. The critical value method determines the critical mean value required for z to be in the rejection region and uses it to test the hypotheses.

When testing a claim about population mean μ, we can assume the random variable X is normally distributed, i.e. the sample appears to come from a normally distributed population and the sample size must be relatively large (many books recommend at least 30 samples).



Hypothesis testing is by using the probability value (p value) referred to as observed significance level. The p-value is defined as the smallest value of α for

which the null hypothesis can be rejected. If the p-value is less than or equal to α, we reject the null hypothesis ($p \leq \alpha$). If the p-value is greater than α, we do not reject the null hypothesis ($p > \alpha$).

Range of p-values	*Rejection range*
p-value >0.10	*Cannot reject the null hypothesis for commonly accepted values of alpha*
0.05<p value < 0.10	*Reject the null hypothesis for alpha = 0.10*
0.01 < pvalue ≤0.05	*Reject the null hypothesis for alpha =0.05*
0.001< p value ≤0.01	*Reject the null hypothesis for alpha =0.01*
0.0001≤pvalue ≤ 0.001	*Reject the null hypothesis for alpha =0.001*

References

Bell, Judith, (2004). *Doing your research project*. United Kingdom: Open University

Black, Ken. (2012). *Applied business statistics*. New Delhi: Wiley India.

Bryman, A. (2012). *Social research methods*. United Kingdom: Oxford University Press.

Cohen, Louis, Lawrence, Manion & Keith, Morrison. (2013). *Research methods in education*. Routledge, Taylor & Francis group.

Creswell W. John. (2014). *Educational research*. New Delhi: PHI Learning.

Filck, Uwe, (2011). *Introducing research methodology*. New Delhi: Sage Publications.

Gay, L. R., Geoffrey E. Mills & Peter Airasian. (2012). *Educational research: Competencies for analysis and applications*. New York: Pearson.

Goode & Hatt cited in Neogi, U.K. (2011). *Research methodology: Tools and techniques*. New Delhi: Variety Books Publishers.

Guthrie, Gerard. (2010). *Basic research methods: An entry to Social Science research*. New Delhi: Sage Publications.

Kaplan, Abraham. (1964). *The conduct of inquiry*. California: Chandler Publishing Co.

Krishnaswami, O.R., Ranganatham, M. & Harikumar, P.N. (2018). *Research methodology*. Mumbai: Himalaya Publishing House.

Mangal, S.K. & Shubhra Mangal, (2013). *Research methodology in behavioural sciences*. New Delhi: PHI Learning.

Medawar,P.B. (1972). *The hope of progress*. London: Methuen. In Bell Judith (2004). *Doing your research project*. Berkshire: Mc Graw- Hill Education.

Neuman, Lawrence, W. (2012) *social research methods: Quantitative and qualitative Approaches*. New Delhi: Dorling Kindersley.

Simcock & Hayne, citd in Mc Burney, Donald, H. & Theresa L. White. (2007). *Research methods*. New Delhi: Akash Press.

Webster, Marriam (1983). *Collegiate dictionary*. Springfield, MA: Merriam Webster,

Wiersma, William, & Stephan G. Jurs. (2009). *Research methods in education*. New Delhi: Dorling Kindersley.

Young, P.V. quoted in Neogi, U.K. (2011). *Research methodology: Tools and techniques*. New Delhi: Variety Books Publishers.