

# THE ROLE OF LOGIC IN RESEARCH

DANJUMA GOLESH(1), ZULAI J. BABA GIREI(2), FARIDA IBRAHIM(3).

1,2, Nigerian building and road research institute

No10 I.T Igbani street abuja

3,Federal capital development agency

Abuja

## ABSTRACT

The role of Logic in research is key as it aids in arriving at valid conclusions in research studies. This study aims to establish through a literature review; the branches of Logic, the approaches to research and the application of various branches of Logic to research. Findings are that; Logic is categorized as Inductive and deductive, and can apply to theory testing and Theory building studies both in combination and in mutual exclusivity.

Keywords: **Deductive, Inductive, Inference, Theory testing, Theory building.**

## 1. INTRODUCTION

The Encarta dictionaries (2009), defines Logic as that branch of science dealing with the principles of valid reasoning and argument. It explains further that; Logic is also a branch of philosophy that deals with the theory of deductive and inductive arguments and aims to distinguish good from bad reasoning.

### 1.1. Definition of terms

**Inference:** A conclusion drawn from evidence or reasoning (Encarta, 2009). It is also defined as an idea that is suggested by the facts or details in a passage ([www.irsc.edu](http://www.irsc.edu))

**Premise:** A premise is described as a proposition that forms the basis of an argument or from which a conclusion is drawn (Encarta, 2009). *Premises* are assertions that, when joined together, will lead the reader to the conclusion (Gambrill, n.d.).

**Arguments:** This is defined as a set of claims, one of which is the conclusion and the rest of which are the premises (Forster, 2004).

**Reasoning:** Reasoning is the set of processes that enables us to go beyond the information given (www.home page. Psy.utexas.edu).

However, Suppes (1957) posited that, Logic as a philosophy encourages careful and precise reasoning in systematic knowledge acquisition. Suppes (1957) further adds that the theory of correct reasoning is also referred to as the theory of logical inference, the theory of proof or the theory of deduction of which the aim is to correctly predict phenomena before the phenomena are observed.

Research, on the other hand, is defined as systematic investigation to establish facts or collect information on a subject (Nouri, n.d). The arrival at these facts is usually established through the application of logic (www.ocw.mit.edu, 2012).

Given the foregoing, through a literature review, this study seeks to examine the role of Logic in Research. It sets out to achieve this through exploration of the following objectives;

- a. Branches of Logic
- b. Approaches to research.
- c. Application of Logic in research.

## 2.0 BRANCHES OF LOGIC

The ability to distinguish correct from incorrect reasoning is the task of logic (Hardegree, n.d). Reasoning however, is a special mental activity called inferring which can also be called making inferences and ‘to infer’ is to draw conclusions from premises (Ibid). This establishes the background for categorising logic as; the various categories of logic are distinguished by the methods of drawing inferences. Stock (1888), categorises logic as either;

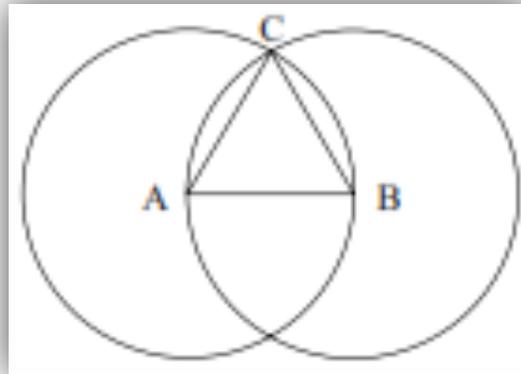
- a. Deductive
- b. Inductive

### 2.1 Deductive logic

Deductive, is derived from the root word deduction which the EncartaDictionaries (2009), defines as the process of drawing a conclusion from available information, in other words, the forming of conclusions by applying the rules of logic to a premise. Deductive logic is about the validity of arguments. It is noteworthy to mention that, an Argument is defined as a set of claims, one of which is the conclusion and the rest of which are the premises (Forster, 2004) while a premise is described as a proposition that forms the basis of an argument or from which a conclusion is drawn (Encarta, 2009). An argument is valid when its conclusion follows deductively from its premises. For clarity, the first theorem Euclids *Elements* will be presented as an example to illustrate the process of deductive logic. Note that this example is as presented by Forster (2004);

Suppose we construct a triangle in the following way (see Fig. 1.0): Draw a circle centred at point A. Mark a point B on the circumference and draw a line from A to B. Draw a second circle centred at B that passed through A. Mark one of the points at which the circles intersect

as C and draw lines from C to A and from C to B.



**Fig 1:** Euclid's construction of an equal-sided triangle.

Source: Forster, 2004.

**Theorem:** All the sides of the triangle ABC are of equal length.

**Proof:** Let  $|AB|$  denote the length of the line segment AB, and so on.

**Step 1:**  $|AB| = |AC|$  because they are radii of the circle centered at A.

**Step 2:**  $|BA| = |BC|$  because they are radii of the circle centered at B.

**Step 3:**  $|AB| = |BA|$  because AB and BA denote the same line.

**Step 4:**  $|AC| = |BC|$  because they are each equal to the same thing (viz.  $|AB|$ ).

**Conclusion:** Therefore,  $|AB| = |AC| = |BC|$  by steps 1 and 4.

It is to be mentioned that, deduction is an important part of mathematical deductions. A simpler representation of deductive logic is the *Socrates is mortal* example which goes thus;

Premise 1: All men are mortal.

Premise 2: Socrates is a man.

Conclusion: Therefore, Socrates is mortal.

It also follows that an argument's deductive validity is possible only if the conclusion follows from the premises available.

## 2.2 Inductive logic

Inductive logic as opposed to deductive, is the process of drawing a conclusion about an object or event that has yet to be observed or occur, on the basis of previous observations of similar

objects or events (Encarta, 2009). In an inductive inference, the evidence provides premises or support for the conclusion. The basic principle behind induction is that if an experiment is frequently performed and a certain result occurs most of the time, then we can say with some degree of confidence that the result will continue to occur if the experiment is repeated often under circumstances essentially the same (Ackroyd & Ramis, n.d).

The process of inductive logic is distinguished from deductive logic by the fact that inferences are drawn from evidential support as opposed to premises as characterised by deductive logic.

An example is outlined below;

By contrast, a reasoner who infers from the belief

(i) All swans that have been observed are white;

to the conclusion

(ii) All swans are white;

is reasoning inductively. The premise provides evidential support for the conclusion, but does not guarantee its truth. It is compatible with the premise that there is an unobserved black swan.

Inductive logic works from the observation of a small part of a population to develop more general hypothesis and theories.

Once an experiment has been carried out and data collected and analyzed, scientists look for whatever pattern their results produce and try to formulate a hypothesis that explains all the facts observed in an experiment. In developing a hypothesis, scientists employ methods of induction to generalize from the experiment's results to predict future outcomes, and deduction to infer new facts from experimental results (Encarta, 2009).

In summary, both notions of deduction and induction, define systems of logic the purpose of which is to solve problems, in the one case by looking for a general characteristic

(generalization, conclusion, conjecture, supposition, inference, etc.) in a set or group of observations, in the other to identify a particular instance through its resemblance to a set or group of known instances or observations (Mill, 1982).

### **3.0 APPROACHES TO RESEARCH**

Research as earlier defined is a systematic investigation to establish facts or collect information on a subject. Primarily research tries to present information on what is not known or more about what is known. It is of particular relevance to identify two major styles of research considering that the primary aim of this study is establish the role of logic in research. The two major styles of research as posited by [www.nyu.edu](http://www.nyu.edu) are;

- i. Theory building
- ii. Theory testing

Both styles of research aim at adding to knowledge but with significantly varied logical approaches to the acquisition of knowledge.

In theory building as posited by [www.nyu.edu](http://www.nyu.edu), it is a process in which research begins with observations and uses inductive reasoning to derive a theory from these observations. Theory testing on the one hand begins with a theory and uses theory to guide which observations to make: it moves from the general to the particular (see figure 2).

These variations in research approach shall be elaborated further in succeeding sections.

### **4.0 APPLICATION OF LOGIC IN RESEARCH**

The preceding section establishes that inductive logic applies to theory building approaches while deductive logic applies to theory testing approaches. This section shall seek to elaborate on the role of these branches of logic in research.

#### **4.1 Theory building**

Theory building in research attempts to make sense of observations. Because the theory is produced after observations are made it is often called post factum theory. Through the inductive approach, plans are made for data collections, after which the data are analysed to see if any patterns emerge that suggest relationships between variables. From these observations it may be possible to construct generalisations, relationships and even theories (Gray, n.d). It is advised that care should be taken by the researcher not draw hasty conclusions or inferences from the data but should rather take multiple cases or instances to increase reliability. It is noteworthy to mention that the inductive approach does not intend to falsify or corroborate a theory but rather through a process of data gathering, sets out to establish patterns consistencies and meaning.

#### **4.2 Theory testing**

The theory testing approach moves towards deductive logic and hypothesis testing, after which the principle is confirmed, refuted or modified. These hypotheses present an assertion about two or more concepts that attempts to explain the relationship between them. Concepts themselves are abstract ideas that form the building blocks of hypotheses and theories. The first stage, therefore, is the elaboration of a set of principles or allied ideas that are then tested through empirical observation or experimentation (Gray, n.d).

Figure 2 illustrates the theory building and theory testing approaches to research;

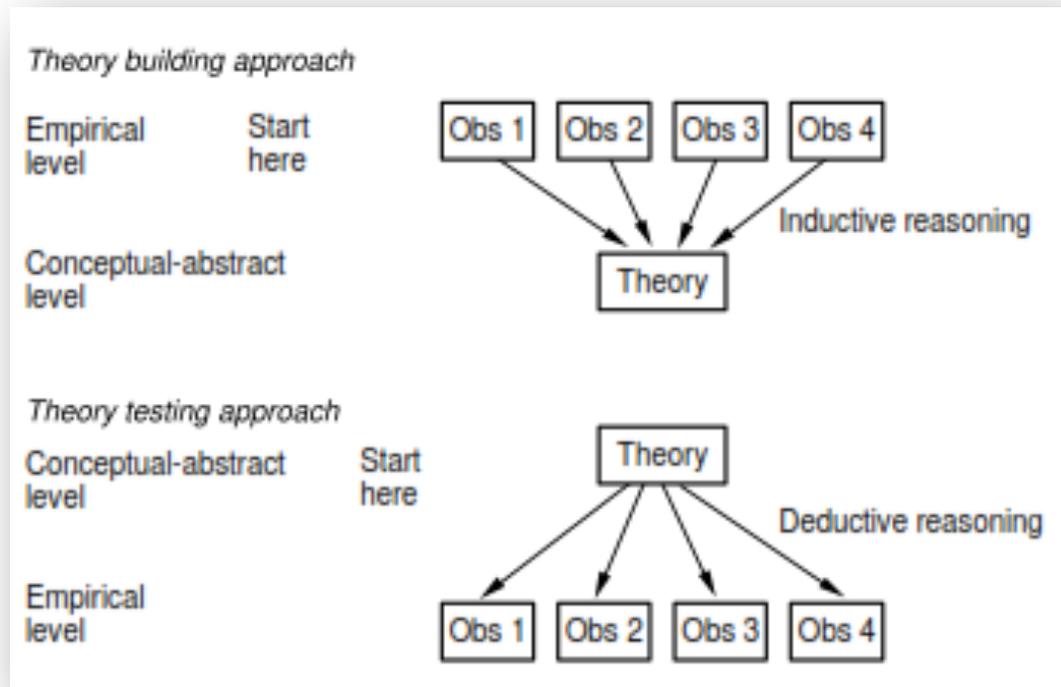


Figure 2: theory building vs. theory testing approach.

Source: [www.nyu.edu](http://www.nyu.edu).

#### 4.3 Combining the inductive and deductive methods

Studies by Gray (n.d) also indicate that the deductive and inductive methods are not mutually exclusive, he posited the possibility of combining the deductive and inductive methods in a study.

He illustrates further by the following example;

Adapting Dewey's (1933) formulation to a modern problem, let us say a researcher has been asked to investigate the problem of staff absenteeism. Taking a selection of facts (absentee rates over time, in different departments and across staff grades), the researcher is able to formulate a theory (inductive approach) that absenteeism is related to working patterns (see Figure 2.1). It is particularly rife among lower grade workers who are the objects of quite rigorous supervision and control. The researcher then becomes interested in what other impact this form of control may have on working practices (deductive approach). A working hypothesis becomes formulated that over-zealous supervision has produced low morale and therefore low productivity levels

among sections of the workforce. This hypothesis is tested by the introduction of new working methods in some sections, but not others (an experimental approach using a control group), to compare productivity levels between traditionally supervised sections and those using the new supervision methods. Figure 3 provides a summary of this process.

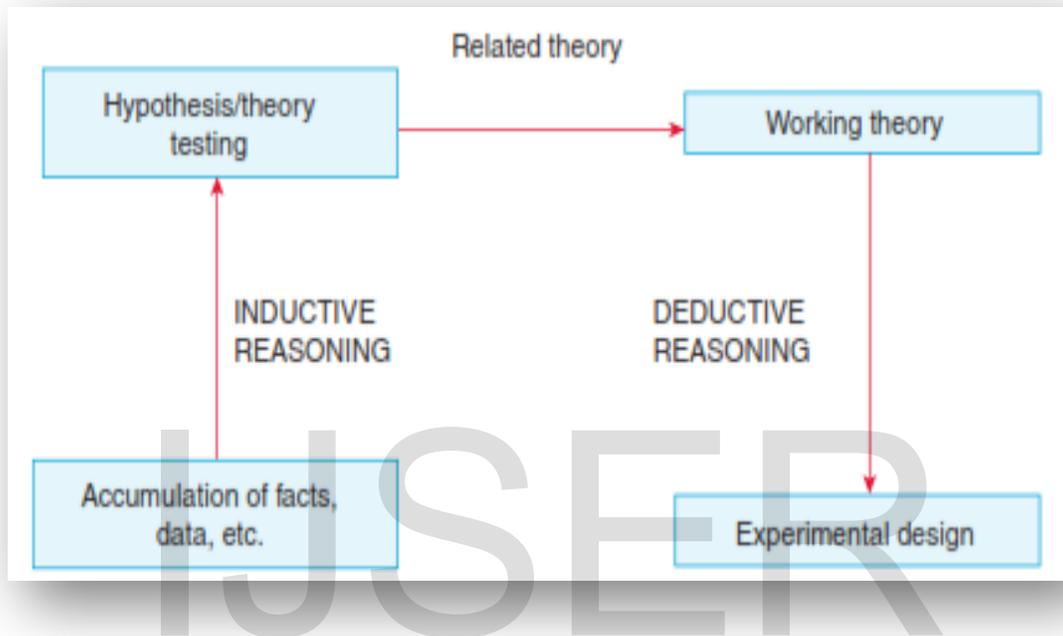


Figure 3: an illustration of how the inductive and deductive methods can be combined.

Source: <http://www.sagepub.com/upm-data/>

58626\_Gray\_\_Doing\_Research\_in\_the\_Real\_World.pdf

## 5.0 CONCLUSION AND RECOMMENDATION

Giving the foregoing, the following can be inferred;

- a. The application of Logic in research is imperative as it gives validity to conclusions or inferences drawn from a research study.

- b. It is observed that in the application of deductive logic, it is more appropriate to theory testing researches and valid outcomes or inferences can be realized only when the premises are valid and the conclusion follows suit. While reliability of outcome in theory building researches is achievable using an inductive approach when conclusions are based on multiple cases or instances.
- c. It is also observed that the degree of reliability Logic adds to research outcomes is dependent on the nature of research and applied branch of logic.
- d. It is noteworthy to add that the different branches can be applied to research mutually exclusively and in combination as elucidated under section 4.3.

Recommendation are that researchers should establish what type of research approach is necessary for any given study so as to be able to determine what branch or branches of logic are applicable.

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