

Scientific Approach

Lecture 1

Rev. Dr Sahaya G. Selvam
selvam@donbosco.or.tz

Thanks to Dr Joanna Collicutt (Oxford HM College)



Institute of Youth Studies
 Tangaza University College, Nairobi



www.sahayaselvam.org

2

What is Research?

- A systematic (**scientific**) enquiry into understanding and/or explaining any phenomenon.
- A good research is worthy of being made public, and thus contributes to human knowledge – to enhance life.
- A good research is replicable and generalisable.

www.sahayaselvam.org

2



What is Science?

www.sahayaselvam.org

3

Science Vs. Non-Science

Scientific Enquiry	Non-Scientific Enquiry
<ul style="list-style-type: none"> • Relies on empirical evidence • Reliability (repeatability) • Cumulative • Establishing Correlation and Cause-Effect relationship • Falsifiability (Popper) 	<ul style="list-style-type: none"> • Relies on logical evidence • May not be repeatable • Coherent and systematic but not necessarily cumulative • Understanding of reality and the interaction between aspects of reality (God, world, humans). • Non-falsifiability
Examples: Physical Sciences Sociology Psychology – Experimental and Clinical	Theology Philosophy Literature

www.sahayaselvam.org

4

Science Vs. Non-Science

Important to note the following points:

- But non-science is not non-sense (Popper)
- Empirical approach is characterised by its thorough and systematic use of data.
- Data interacts with existing theories, modifies them, creates new theories and models.
- The empirical approach does not entail positivism! (Wait until 3rd lecture for the -isms!!)

www.sahayaselvam.org

5

General Procedure of Science (1)

Francis Bacon (1561-1626):

1. Phenomenon: Experience!
 - Anecdote and unsystematic observation generates questions – research questions!
2. Generation of Hypothesis:
 - Generated on the basis of existing explanations/theories;
 - (Literature Review)
 - A hypothesis is trial idea; a reasonable guess; a theory in the making;

www.sahayaselvam.org

6

General Procedure of Science (2)

3. Testing of Hypothesis: Observation & Experimentation:

- Data will support or reject the hypothesis;
- Observation might lead to further description and establishing correlation;
- Limited predictability could be possible on the basis of correlation (regression)
- Causality can be established (only) through rigorous experimentation.

4. Stating of model, theory, principle, or law

- A model is a representation that *describes* or *illustrates* underlying dynamics in the given phenomenon.
- A theory *explains* (often the cause-effect relationship) the interaction in the phenomenon. (Theory of Evolution is not a hypothesis!)
- A principle is an explanation based on observation and logic. Similar to theory.
- A law is a non-accidental general statement with unrestricted universality.
- A conjecture is weaker statement than a hypothesis.

www.sahaysselvam.org

7

A closer look at Scientific Theory

"An explanation using an integrated set of principles that organises and predicts observations"

A Good theory is...

1. Reliable
2. Valid
3. Useful for prediction
4. Testable (falsifiable)
5. Cumulative
6. Parsimonious
7. Public

www.sahaysselvam.org

8

Some concepts and terms to be familiar with...

www.sahaysselvam.org

9

1. Models and Theories

- Models: representation of the 'real' world out there.
- Theory: explanation of how the world functions.

"I propose to conceive of economic 'theories' as sets of beliefs about the economy and how it functions. They refer to the 'real world' - that curious expression that economists use when it occurs to them that there is one. 'Models' are formal but partial representations of theories. A model never encompasses the entire theory to which it refers" (Leijonhufvud, 1997).

www.sahaysselvam.org

10

2. Causation vs. Correlation

- Correlation – association between independent and dependent variables
- Causation – relationship between independent and dependent variables such that a change in an independent variable (predictor) will change the dependent variable (outcome) in a known way

www.sahaysselvam.org

11

An Example

When I travel or not slept for some night I find myself very tired. And I will definitely have an attack of malaria.

- Correlation?
- Causal effect?
 - look for factors not included in the correlation

www.sahaysselvam.org

12

3. Reliability & Validity

- **Reliability:** The confidence that a given empirical finding can be reproduced.
- **Validity:** The confidence that a given finding shows what it purports to show. That is, it is close to reality.
- **Example:**
IQ tests: high reliability, low validity!

www.sahaysselvam.org

13

Independent and Dependent Variables

- Variables are constructs that being examined in a study.
 - Eg. Do breast-fed infants grow up to be more intelligent than bottle-fed infants.
 - Variables: breast-feeding, bottling-feeding, intelligence.
- The "dependent variable" represents the output or effect, or is tested to see if it is the effect. The "independent variables" represent the inputs or causes, or are tested to see if they are the cause.
 - IV: Breast-feeding and Bottling-feeding conditions
 - DV: Intelligence.

www.sahaysselvam.org

14

Type I and Type II Errors

- **Type I error:** Claiming a certain finding (or a statistical value) that is not there in reality. It happens when the instrument of measure is too sensitive, or benchmark is too low.
- **Type II error:** Not finding (or a statistical value) that is actually there in reality. It happens when the instrument of measure is not sensitive enough, or benchmark is too high.

www.sahaysselvam.org

15



**Think of
a Research Question**

www.sahaysselvam.org

16