

Research Methodology

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7th September, 2022

Types of Variables

- There are four types of variables
 - 1 Independent Variables
 - 2 Dependent Variables
 - 3 Extraneous Variables
 - 4 Intervening Variables

Types of Variables

- **Independent Variable:** The variables are independent to each other, the output of a variable does not affect the others
- **Dependent Variables:** The output of any variable will depend on the outputs of others
- **Extraneous Variable:** Several other factors operating in a real life situation may affect the outputs of dependent variables. These factors may increase or decrease the relationship or strength of the relationship between independent and dependent variables
- **Intervening Variable:** Sometimes called the confounding variable (Grinnell 1988). It links the independent and dependent variable. In certain situation the relationship between an independent and dependent variable can not be established without the intervention of another variable. The assumed effect can only be achieved in the presence of an intervening variable

- Let us consider the relationship between *smoking* and *cancer*
- Your assumption is *Smoking Causes Cancer*
- Studies have shown that there are many factors affecting this relationship
- Factors may include
 - 1 Number of cigarettes
 - 2 Amount of tobacco smoked everyday
 - 3 The duration of smoking
 - 4 The age of the smoker
 - 5 Dietary habits
 - 6 Amount of exercise taken by the individual etc.

Examples

- All of these factors may affect the extent to which smoking might cause cancer
- These variables may increase or decrease the magnitude of the relationship
- In this example the extent of smoking is the independent variable
- Incidence of cancer is the dependent variable
- And all other variable that might affect this relationship, positively or negatively, are extraneous variables

- Let us consider another example
- Assume the relationship between the influence of counselling service and the marital problems
- The type of counselling service is independent variable
- Whereas, the extent of marital problems is dependent variable
- The magnitude of strength of this relationship can be affected, positively or negatively, by a number of other factors

- These extraneous variables might be
 - 1 the birth of a child,
 - 2 improvement of family's economic condition,
 - 3 the couple's motivation to change the situation
 - 4 the involvement of third person
 - 5 self realisation
 - 6 pressure from relatives and friends etc.
- Extraneous variables can work both ways, i.e., can increase or decrease the strength of the relationship

Intervening Variables

- Let us consider the following concept
Reduction in child mortality is assumed to be the cause of reduction of fertility
- Here, *Reduction of child mortality* is independent variable and *Reduction of fertility* is dependent variable
- The reduction of child mortality will increase the family size
- An increase of family size creates a number of social, economic, and psychological pressures on families which in turn create attitude favourable to a smaller family size

Intervening Variables

- This change in attitude is eventually operationalised in the behaviour through the adoption of contraceptives
- If people do not adopt the method of contraception, a change in mortality level will not be reflected in fertility level
- Hence, we need to consider the acceptance level of contraceptive by the society
- This is the example of intervening variable

Intervening Variables

- However, the adoption of contraceptive method will depend on the following
 - ① attitude,
 - ② education,
 - ③ age,
 - ④ religion etc.
- These are the extraneous variables which affect the relationship between the dependent and independent variables
- However, in this specific case, without the consideration of the intervening variable the study will be incomplete

Active and Attribute Variables

- **Active Variables:** Variables that can be manipulated, changed or controlled
- **Attribute Variables :** Variables that can not be manipulated, changed, or controlled and that reflect the characteristics of the study population, for example age, gender, education, and income

Examples

- Suppose, a study is designed to measure the relative effectiveness of three teaching models (A, B, and C)
- The structure and contents of these models could vary and any model might be tested on any population group
- The contents and structure can also be different from researcher to researcher
- However, a researcher has no control over characteristics of the student population such as their age, gender or motivation to study
- Here, the teaching techniques are the *active variables* and the characteristics of the study population are the *attribute variables*

Types of Measurement Scale

- Nominal or Classificatory Scale
- Ordinal or Ranking Scale
- Interval Scale
- Ratio Scale

Nominal or Classificatory Scale

- a nominal scale enables the classification of individuals, objects or responses based on a common/shared property or characteristic
- such individuals, objects or responses are divided into number of subgroups in such a way that each member of the subgroup shares a common characteristic or a property
- A variable measured on a nominal scale may have one, two or more subcategories depending upon the extent of variation
- For example, 'Man' and 'Woman'; each has one subgroup
- However, 'Religion' has many subcategories, such as, Hindu, Muslim, Christian etc.

Ordinal or Ranking Scale

- An ordinal scale has all the properties of a nominal scale-categorising individuals, objects, responses or a property into subgroups on the basis of a common characteristic, but also ranks the subgroups in a certain order
- They are arranged in either ascending or descending order according to the extent to which a subcategory reflects the magnitude of variation in the variable
- For example, 'income' can be subcategorised by labelling as 'above average', 'average', 'below average' etc, where you may consider average income range between Rs. 40,000/month and Rs.50,000/month and arrange the people accordingly

Interval Scale

- Interval scale uses a unit of measurement that enables the individuals or responses to be placed at equally spaced intervals in relation to the spread of the variable
- This scale has a starting point and ending point
- The space/gap between the starting and ending point is divided into equal unit/intervals
- Celsius and Fahrenheit scales are the examples of interval scale

Ration Scale

- It provides the ration of some variables under measurement
- It has also a starting point and end point
- A ration scale always has a reference point/frame; based on that the ration has been calculated
- For example, if in a ration scale the reference point is 20 years of age, then 2 implies 40 years of age, 3 implies 60 years of age and so on

- Research Methodology; a step by step guide for beginners, Ranjit Kumar, Fifth Edition, 2019

Literature Review

- In the initial phase a scholar would be wondering how and wherefrom to get enough literature.
- By the end of a year the same scholar would be worried what to do with so much literature :-)

Literature Review: Basics

- Literature Review is the most Important activity which is repeated several times or is done in a continuous manner during the PhD research project
- Undertaking a review of the literature allows to
 - Define what the field of study is by identifying the theories, research, and ideas with which the study connects
 - Provide the idea about the existing research, i.e., what theories, concepts, methods, approaches and models have already been used and applied in the field of study by other researchers
 - Identify the "gaps" or further contribution that the present piece of research may make

Literature Review: Basics Contd.

- The literature review is generally carried out in approximately three phases
 - ① Initial
 - ② Intermediate
 - ③ Late/final
- Initial Literature Review: Helps formulating and appreciating the research area
- Intermediate Literature Review
 - To put own work in the perspective of existing and evolving knowledge.
 - To obtain supporting evidences and counter examples
- Late Literature Review: To confirm novelty of own work

Difference Between Literature Survey and Literature Review

- Some researchers make a clear distinction between literature survey and literature review
- According to those researchers
 - Literature survey only states what is available in the literature
 - Literature review means a more critical analysis of existing literature

Activities at Initial Literature Survey

- Make a list of few books/conference proceedings relevant to the study
- Identify one or two earlier survey papers
- Make a list of relevant papers (say 100 papers)
- Make a document with the abstracts of 10 most important papers
- Try to refine your understandings

Activities at Intermediate Literature Survey

- Prepare a first draft of the literature review chapter
- Try to identify the relation/difference between own work and existing literature
- There are some dedicated journals like ACM Survey
- You may publish your survey paper too if prepared carefully

Efforts Involved

- Searching and Finding relevant literature
- Evaluating the literature after cursory, casual and critical reading
- Finding link between literature and proposed own work.
- Refining the definition of proposed own work.
- Writing the review in several passes.

Evolving Nature of Literature Survey

- The nature of work in the literature review phase evolves over time
- The first few months could be a kind of 'Brownian motion', searching without knowing what to search
- The work would eventually become more focused as part of a proposal
- After the draft survey paper is completed, one gradually settles down to the research proper and the literature review takes a back seat

Evolving Nature of Literature Survey Contd.

- The aspirant's survey and review does not end with the survey paper. The aspirant should continue to keep the literature survey throughout his/her Ph.D life cycle to be aware with the new developments in the field
- The literature review may need major revision, or has to be tackled properly in the light of your knowledge, maturity and wisdom which will improve with time
- The new significance of some of the literature that were glossed over earlier may become clear
- You may need to explore the literature that did not initially seem to be of direct relevance
- Of course, the opposite may also happen, i.e., the literature may not seem significant any more and need to be dropped

Supervisor's Role in Literature Survey

- It is quite likely that the supervisor has a fair idea about the available literature, more so if it is the supervisor who selected or defined the research area
- Despite this, the supervisor may not dish out the literature to the aspirant, because he wants that the candidate:
 - Learns how to search, select and understand the literature
 - Gets a solid grounding about the basics
 - Get convinced that what is being attempted is novel, has not been done before

Sources of Literature Survey

- Various library
 - National library
 - ISI library
 - IACS library
 - JU library
 - CU library, etc.
- Online resoures
 - arxiv.org
 - eprint.iacr.org
 - IEEE explore
 - ACM Digital Library
 - Research Gate etc.

How to Begin

- To begin your search for literature, you need the following kit:
 - ① a paper to start from or a set of keywords
 - ② A rough title/ problem statement of your research
- Knowledge that you are in Phase-zero of your literature review
- Objective: to get a toe-hold in the vast tree of knowledge

Literature Review: The Icebreaker or a Nut Cracker?

- If you are given a starting paper, great!
 - Try to read its title, abstract and the introduction
 - If you can make out something, great!
 - You have broken some ice
- If you cannot understand a thing, that too is great
 - You are challenged and the adrenaline should start flowing

How to Search

- Identify at least four keywords from your given keywords and/or from the starting paper
 - At least two of them from problem/causative domains
 - At least two of them from solution/impact/measurement domains
- Example
 - Starting paper: “Gold Mining as a Source of Mercury Exposure in the Brazilian Amazon
 - Keywords from paper: mercury; amazon; air; fish; hair; urine; human risk
 - Keywords from Supervisor: mercury pollution, river, weed,
 - Additional Keywords from abstract and sympathetic listeners: gold mining
 - Causative Keywords: gold mining , metal recovery
 - Impact Keyword: mercury pollution, river

How to Search

- Once a suitable book, survey paper or a thesis is obtained, phase zero search may be considered to be over
- After reading the resource somewhat thoroughly, the aspirant would have an understanding of the general area and may proceed to the next phase of search
- By then crack-lines have appeared on the ice sheet or on the hard nut.

Scanty of Literature

- Occasionally a student will complain that 'There isn't any literature' on their topic
- Apart from being suspicious about strong urge to do nothing, there might be some real reasons too
 - ❶ Wrong keywords
 - ❷ Wrongly spelt keyword
 - ❸ Too narrow focus, AND-ing of several Keywords
 - ❹ Relevant databases have not been searched
- If the above factors are eliminated and there are no significant literature, it is a significant finding :-)
- You are probably going to open up a new avenue :-)
- The supervisor would then come to your rescue and help you to creatively utilize the null finding and suggest alternative sets of keywords

Searching in Retrochrony

- Retrochrony means in reverse time
- From a starting paper, consult the reference section and try to access an immediate predecessor paper
- Apply the same technique on the predecessor papers to find older papers
- The idea is to go to the most recent but understandable paper
- For Example
 - Start with only a few current literature. (conference publications preferred)
 - Trace back the bibliography to about (-3) to (-6) years (conf and journal)
 - Study the literature for the period (-6) to (-3) yrs, locate the papers which are understandable
 - Study only these older papers
 - Form tentative research directions (short list) from these older publications

Things to be Noted During Literature Survey

- The author or authors
- The title of the paper, report or book
- The date of publication
- If it is a book or report, the publisher and place of publication (and the edition, if there has been more than one)
- If it is a chapter in an edited book, the title and editor of the book, and the page numbers of the chapter
- If it is a paper in a journal, the title of the journal, volume and issue number, and pages
- If it is a web site, the address and the date you accessed the information.

- T. K. Ghoshal, Research Methodology, Jadavpur University, 2013