Keynote Address of 3rd Ruhuna Arts Students' Annual Sessions (RASAS0-2018)

What should you know before conducting a 'Scientific Research'? A brief note

Honorable sirs, colleagues and Dear students,

It is a great honor for me to be invited to deliver the keynote address on this special occasion today. I consider that you have privileged me to express my own views and perspectives to the academic and student's community in the Faculty of Arts in your esteemed university. I thought it is more appropriate to begin my lecture referring to the first occasion I came to know about this meeting. A couple of weeks ago Dr. Chandima Gayatri Wijesundara of your faculty, called me to ask my consent to accept the invitation to deliver the keynote address of the Faculty students' session of her university. I accepted it with immense pleasure. Since then I was so eager to find a suitable theme for the talk. In the meantime, Dr. Gayatri called me for the second time together with Ms. Dushmanthi Silva and inquired about my preparation and they asked if I could talk on something like encouraging students in social science research would be fine. On behalf of the Vice chancellor, Dean and the members of organizing committee of this conference, thank you very much Dr. Gayatri and Dushmanthi, for their concern and the kindness conveyed. However, I thought it is good to share some ideas on 'Scientific research' particularly on human sciences which I am professionally qualified to talk on.

Let me begin with what is research? Depending on who you ask, you will likely get very different answers to this seemingly harmless question. Some people will say that they routinely research different online websites to find the best place to buy

goods or services they want. Television news channels supposedly conduct research in the form of viewer polls on topics of public interest such as forthcoming elections or government-funded projects. Undergraduate students research the Internet to find the information they need to complete assigned projects or term papers. However, none of the above can be considered "scientific research" unless: (1) it contributes to a body of science, and (2) it follows the scientific method. My talk today will investigate the nature of 'Scientific Research'. Although instances of scientific progress have been documented over many centuries, the terms "science," "scientists," and the "scientific method" were coined only in the 19th century. Prior to this time, science was viewed as a part of philosophy, and coexisted with other branches of philosophy such as logic, metaphysics, ethics, and aesthetics, although the boundaries between some of these branches were blurred.

What is Science?

Etymologically, the word "science" is derived from the Latin word scientia meaning knowledge. Science refers to a systematic and organized body of knowledge in any area of inquiry that is acquired using "the scientific method" (the scientific method is described further below). Science can be grouped into two broad categories: natural science and social science. Natural science is the science of naturally occurring objects or phenomena, such as light, objects, matter, earth, celestial bodies, or the human body. Natural sciences can be further classified into physical sciences, earth sciences, life sciences, and others.

In contrast, social science is the science of people or collections of people, such as groups, firms, societies, or economies, and their individual or collective behaviors.

Social sciences can be classified into disciplines such as psychology (the science of human behaviors), sociology (the science of social groups), and economics (the science of firms, markets, and economies).

The natural sciences are different from the social sciences in several respects. The natural sciences are very precise, accurate, deterministic, and independent of the person making the scientific observations. The goal of scientific research is to discover laws and postulate theories that can explain natural or social phenomena, or in other words, build scientific knowledge. It is important to understand that this knowledge may be imperfect or even quite far from the truth. The progress of science is marked by our progression over time from poorer theories to better theories, through better observations using more accurate instruments and more informed logical reasoning.

We arrive at scientific laws or theories through a process of logic and evidence. Logic (theory) and evidence (observations) are the two, and only two, pillars upon which scientific knowledge is based. In science, theories and observations are interrelated and cannot exist without each other. Theories provide meaning and significance to what we observe, and observations help validate or refine existing theory or construct new theory. Any other means of knowledge acquisition, such as faith or authority cannot be considered science.

Both theory and observations are essential components of scientific research. For instance, relying solely on observations for making inferences and ignoring theory is not considered valid scientific research. Depending on a researcher's training and interest, scientific inquiry may take one of two possible forms: inductive or deductive. In inductive research, the goal of a researcher is to infer theoretical

concepts and patterns from observed data. In deductive research, the goal of the researcher is to test concepts and patterns known from theory using new empirical data. Hence, inductive research is also called theory-building research, and deductive research is theory-testing research. Note here that the goal of theory-testing is not just to test a theory, but possibly to refine, improve, and extend it. It is important to understand that theory-building (inductive research) and theory testing (deductive research) are both critical for the advancement of science. Elegant theories are not valuable if they do not match with reality. Likewise, mountains of data are also useless until they can contribute to the construction to meaningful theories.

Theory building, and theory testing are particularly difficult in the social sciences, given the imprecise nature of the theoretical concepts, inadequate tools to measure them, and the presence of many unaccounted factors that can also influence the phenomenon of interest. It is also very difficult to refute theories that do not work. Unlike theories in the natural sciences, social science theories are rarely perfect, which provides numerous opportunities for researchers to improve those theories or build their own alternative theories.

Conducting scientific research, therefore, requires two sets of skills – theoretical and methodological – needed to operate in the theoretical and empirical levels respectively. Methodological skills ("know-how") are relatively standard, invariant across disciplines, and easily acquired through degree programs. However, theoretical skills ("know-what") is considerably harder to master, requires years of observation and reflection, and are tacit skills that cannot be “taught” but rather learned though experience. So, methodological skills are needed to be an

ordinary researcher, but theoretical skills are needed to be an extraordinary researcher!

Any branch of inquiry that does not allow the scientific method to test its basic laws or theories cannot be called "science." For instance, theology (the study of religion) is not science because theological ideas (such as the presence of God) cannot be tested by independent observers using a logical, confirmable, repeatable, and scrutinizable. Similarly, arts, music, literature, language, and law are also not considered science, even though they are creative and worthwhile endeavors in their own right. The scientific method, as applied to social sciences, includes a variety of research approaches, tools, and techniques, for collecting and analyzing qualitative or quantitative data. These methods include laboratory experiments, field surveys, case research, ethnographic research, action research, and so forth.

Types of Scientific Research:

Depending on the purpose of research, scientific research projects can be grouped into three types: exploratory, descriptive, and explanatory. Exploratory research may not lead to a very accurate understanding of the target problem but may be worthwhile in scoping out the nature and extent of the problem and serve as a useful precursor to more in-depth research. Descriptive research is directed at making careful observations and detailed documentation of a phenomenon of interest. Explanatory research seeks explanations of observed phenomena, problems, or behaviors. While descriptive research examines the what, where, and when of a phenomenon, explanatory research seeks answers to why and how types of questions. Most academic or researchers belongs to the explanation

category, though some amount of exploratory and/or descriptive research may also be needed during initial phases of academic research. Seeking explanations for observed events requires strong theoretical and interpretation skills, along with intuition, insights, and personal experience. Those who can do it well are also the most prized scientists in their disciplines.

Thinking like a researcher

Conducting good research requires first retraining your brain to think like a researcher. This requires visualizing the abstract from actual observations, mentally "connecting the dots" to identify hidden concepts and patterns and synthesizing those patterns into generalizable laws and theories that apply to other contexts beyond the domain of the initial observations. Research involves constantly moving back and forth from an empirical plane where observations are conducted to a theoretical plane where these observations are abstracted into generalizable laws and theories. This is a skill that takes many years to develop, is not something that is taught in degree programs or acquired in industry training. Some of the mental abstractions needed to think like a researcher include unit of analysis, constructs, hypotheses, operationalization, theories, models, induction, deduction, and so forth, which I will briefly explain in this section.

One of the first decisions in any social science research is the unit of analysis of a scientific study. The unit of analysis refers to the person, collective, or object that is the target of the investigation. Typical unit of analysis include individuals, groups, organizations, countries, technologies, objects, and such. For instance, if we are interested in studying people's shopping behavior, their learning outcomes, or their attitudes to modern technologies, then the unit of analysis is

the individual. If we want to study characteristics of street gangs or teamwork in organizations, then the unit of analysis is the group. If the goal of research is to understand how firms can improve profitability or make good executive decisions, then the unit of analysis is the firm. In this case, even though decisions are made by individuals in these firms, these individuals are presumed to represent their firm's decision rather than their personal decisions. If research is directed at understanding differences in national cultures, then the unit of analysis becomes a country. Understanding the unit of analysis is important because it shapes what type of data you should collect for your study and who you collect it from.

Without concepts we can't explain our research, Knowingly or unknowingly, we use various kinds of concepts in our everyday conversations. Some of these concepts have been developed over time through our shared language. Sometimes, we borrow concepts from other disciplines or languages to explain a phenomenon of interest. Concepts used for scientific research must have precise and clear definitions that others can use to understand exactly what it means and what it does not mean. Scientific research requires operational definitions that define concepts in terms of how they will be empirically measured.

Etymologically speaking, a variable is a quantity that can vary (e.g., from low to high, negative to positive, etc.), in contrast to constants that do not vary (i.e., remain constant). However, in scientific research, a variable is a measurable representation of an abstract construct. As abstract entities, constructs are not directly measurable, and hence, we look for proxy measures called variables. Thinking like a researcher implies the ability to move back and forth between these two planes. Depending on their intended use, variables may be classified as

independent, dependent, moderating, mediating, or control variables. Variables that explain other variables are called independent variables, those that are explained by other variables are dependent variables, those that are explained by independent variables while also explaining dependent variables are mediating variables (or intermediate variables), and those that influence the relationship between independent and dependent variables are called moderating variables.

A proposition is a tentative and conjectural relationship between constructs that is stated in a declarative form. An example of a proposition is: “An increase in student intelligence causes an increase in their academic achievement.” This declarative statement does not have to be true, but must be empirically testable using data, so that we can judge whether it is true or false. Propositions are generally derived based on logic (deduction) or empirical observations (induction). The empirical formulation of propositions, stated as relationships between variables, is called hypotheses.

Propositions are specified in the theoretical plane, while hypotheses are specified in the empirical plane. Hence, hypotheses are empirically testable using observed data, and may be rejected if not supported by empirical observations. Of course, the goal of hypothesis testing is to infer whether the corresponding proposition is valid.

A theory is a set of systematically interrelated constructs and propositions intended to explain and predict a phenomenon or behavior of interest, within certain boundary conditions and assumptions. Essentially, a theory is a systemic collection of related theoretical propositions. Theories provide explanations of social or natural phenomenon. In the course of scientific progress, poorer

theories are eventually replaced by better theories with higher explanatory power. The essential challenge for researchers is to build better and more comprehensive theories that can explain a target phenomenon better than prior theories. Researchers must be able to move back and forth between inductive and deductive reasoning if they are to post extensions or modifications to a given theory, or built better ones, which are the essence of scientific research particularly in the field of Social Sciences.

As a final note let me say this, it is clear that social science research is of immense importance to societies around the world, however their still is much work to be done to increase the level of support that they receive. One of the key programs that have emerged to champion the social sciences has been the engagement of young researchers in the field of Social Science. In recent years STEM (science, technology, engineering, and maths) sciences have received most of investment and support from government, universities, etc., while these subjects are no doubt important, the importance of social sciences should not be ignored. In fact, in areas such as social and primary care, poverty and inequality the justice system, and business, to name just a few, social science is extremely important, and necessary. It is therefore very important that this educational imbalance be addressed, and more support provided to the social sciences. The choice between STEM and the social sciences is really a false one; society needs people trained in both. In order to formulate effective solutions for society and to understand the implications of those solutions, a mix of both STEM and HMES (humanities, Management, Education and social sciences) will be required. Unfortunately, in Sri Lanka Social science is rarely engaged in collaborative cross-disciplinary work in diverse fields such as natural sciences, engineering, medicine, and computing. It

is clear that no subject area can stand alone, walled off from the outside, and that social science can play an important role in all fields. The young researchers who have gathered here today can play a leading role to bridge this disciplinary gap.

Thank you!

Senior Professor Premakumara de Silva,

Dean/ Faculty of Arts

University of Colombo

20/09/2018