Characteristics and elements of judgment in scientific inquiry (A survey of research methods used by Social Science students of the University of Kelaniya, Sri Lanka)

Habibu Ahamad Isa
University of Kelaniya, Sri Lanka and Gombe State University, Nigeria

Abstract

Science comprises an array of disciplines that tracks objective knowledge with methods that promote objectivity. Facts and truth emerge through rigorous observations and empirical studies of the real world. The scientific community of every institution has formal standards for scientific research that reflect the general theories of scientific methodologies. The continuum of academic knowledge comprises sciences; social sciences; and humanities. The science method is rigorous, hard, and precise, while that of humanities is considered soft and particular. Social science exists between sciences and humanities and it adopts much of the scientific methods applied to different and less predictable types of data. The University of Kelaniya as an institution has several Faculties including Sciences, Social Sciences and Humanities. The Social Science Faculty of Kelaniya University is not exempted from rigorous use of scientific methods; therefore, what methodological standards do their students apply for scientific inquiry? This paper examines characteristics of science and nature of scientific research; methods used in scientific inquiry; and the social science research methods. A sample of 120 respondents was randomly drawn from the category of final year undergraduate and postgraduate students of the Faculty and data collected from them. Also, past research projects written in English medium were analyzed. Results show the application of scientific methodology without standard uniformities. The paper recommends a standard format that will guide all research and report writing in the Faculty, reflecting the nature of the subjects taught and researched in Social Sciences.

Keywords: Characteristics of Science, Scientific Methodology, Social Science Methods, Academic Writing, University of Kelaniya

Introduction

Scientific tradition has been preserved through the activities of the scientific community. This community consists of interacting professionals that practice science, and set up guidelines and norms, behaviours and attitudes, ethical principles, techniques and training, beliefs and values, and vocational routes that bind them together (Neuman, 2007). The professionals in this community originate from natural and social sciences (Mulkay, 1991; Merton, 1973; Hagstrom, 1965). Passively sitting, reading, reflecting and writing or interacting with specific people with little or no analytical basis are not normally thought of as research in the social sciences although, of course, such activity can be just so classified in the humanities (Bauböck, 2008). The goal of social science research is to explain social phenomena; clarify doubtful relations and explain variables; correct the misconceived facts about social life; and seek solutions to social problems (Longino, 1990). In humanities, the goal is generally interpretive rather than explanatory. Ideas are interpreted either synchronically as they exist within their context of origin, or diachronically by translating their historical development and relating them to earlier and later ideas and thus identifying traditions and their evolution over time, (Bauböck, 2008).

Common procedures used across disciplines that claim scientific status bind social and natural sciences together, while usage of specific methodologies is discipline specific because standards of principles and ethics are discretions of subject (Kantorovich, 1993). The scientific method is determined to use systematic techniques for inquiries and fact finding. Regularities of practice coupled with emphatic observation and understanding are the prime means that lead to truth because the method grants possibilities for replication and falsification (Dampier, 1971; Harre, 1967; Popper, 1959). In most social science research there is an element of going and finding out. It is a field-based activity which employs some element of empirical enquiry. Framework is designed to make the activity coherent and allow synchronization of ideas with experience. Processes that will account for the experience are systematically organized in parts and phases. Different parts of the process should make holistic sense and coherently be represented in writing. The scientific method of inquiry is a tradition of social science researchers and is generally used by social science students of institutions of higher learning. This paper sets forth to examine knowledge of the scientific method of inquiry acquired by Social Science students of Kelaniya University; the way they apply it in their research; and the format or steps they normally adopt. The paper also reviews the general characteristics and methods of scientific inquiry, and discusses some common applications of the method in the social sciences.

Review of Literature

The scientific method of inquiry was built on observation and experiment, public criticism and discussion, logic, skepticism, and the rejection of all interference of false

idols and dogmas (Bacon, 1985). Methodological standard is the bedrock that safeguards this authenticity based on the role it plays in governing conduct and defining the aims of science. Scholars like Popper, (1959); Kitcher, (1993); and Lauden, (1990) assert that science's method has distinctive features that distinguish it from others like philosophy, literature, religion and pseudo sciences. Characteristics and steps of scientific studies distinguish it from non scientific writing.

Characteristics of Science and Steps of Scientific Research

Rigidity of methodology and method is the defining feature that separates science from others. It is uniquely empirical, verifiable, analytical, factual, impartial, propositional, reliable, replicable, and logical. Though there is no consensus on single format of steps that is generally adopted by all institutions and departments for application in scientific research, the above features are discussed as follows:

1. **Topic Selection:** It is the first step in scientific research writing. The interest of the topic may arise from personal experience, chance occurrence, interaction with other people, or as a result of reading others' work. Topic selection is subjective at the initial stage but once the choice is made it becomes objective. Science's development begins with the progress made on thoughts and ability for empirical verifications, falsifications, and substitutions of poor theories with better ones through practical test and experience. The research topics in science are verifiable and address empirical and practical phenomena. Practicality of phenomenon gives a clue to its magnitude and allows conceptualization of its nature and possibilities to measure the level or degree to which it influences or affects a system (Nagel, 2006). A research topic must be feasible, empirical and practical.

2. **Identification and Explanation of the Problem:** Formulation of the research problem supports the validity of the topic or otherwise. It is a broad statement that clearly presents a portrait of the gap which the present research is willing to fill, and researcher's familiarity with the problem situation. Definition of research problem leads to a questioning process, which is ubiquitous in sciences. Questioning process exposes a subject for research; an existing problem; and articulated uncertainties or difficulties. Paradoxical thoughts are necessary for the discovery of the unknown, and they are a requirement of science. Many of the most creative aspects of the research process involve questions that translate theories into more precise objectives, hypotheses and tasks (Gomez & Jones, 2010). Formulation of the research problem will clarify the analytical nature of the topic; contribution of the research to the existing field of knowledge; and depth of understanding of the research area.

3. **Statement of Research Objectives:** The broad aim and specific objectives will guide research on where to go and what is needed. Research objectives are directed towards a search for an objective knowledge or facts. Factuality as a feature of science denotes a reputable status of dealing with those things that are actually real. Tasks are governed by the notions of investigations into a phenomenon in its real or actual state of existence. Research objectives are guided by the belief in truth and authenticity of method that led to it (Furseth & Repstad, 2006).

4. **Review of Literature and the Theoretical Framework:** The concepts, variables, hypotheses, theories and paradigms used by science are analytical, and they can be measured. Paradigms are the larger built up theoretical perspectives from philosophical viewpoints which are used to inform methodology and contextualize ground logic. They are discrete historical ideas presenting a logical view of reality and used for test and compatibility of theories (Crotty, 1998; Kuhn, 1970). Scientists use background theoretical models in order to ascertain expectations. The theoretical base or paradigm influences scientists' choice for method; help advancement or modification of used methods; and also determine improvement in use of other procedures (Psillos, 1999).

   The deterministic feature of science permits a trace of antecedent of event. Hence, nothing happens without reason and science's orientation was geared towards systematic observation and empirical verification of knowledge of the antecedents in the physical and social world (Hochberg, 2006). Predictable factors that influence a phenomenon or outcomes of previous events should be reflected in the literature.

   Existing theories and previous findings are independently and impartially analyzed. Consideration of diverse hypotheses, ideas, approaches and models is done, in order to understand shortcomings and guide researchers to control uncertainties that might lead to prejudices or creeds and proved impartiality (Longino, 1990). Likelihood of objectivity is higher when literatures of different cultures, personalities, and styles of thoughts clash together rather than form a consensus of like minded views (Resnik, 1998).

   Literature review increases familiarity with the research area; guides problem and hypothesis formulation; exposes the theoretical aspect of the research, and also guides analysis and interpretation of data. The framework into which the research fits depends on theory and nature of research problem and it brands the research design and underpins other processes of research activities (Walliman, 2006).

5. **Identification of Appropriate Research Design:** Choice of research design is based on the purpose of the research. The research purpose might be geared towards dealing with familiarities; testing hypothesis, determining frequency of occurrences, or examining causation. Exploratory design establishes familiarity with phenomenon; descriptive design portrays characteristics and relations of individuals, groups, situations, events or determines frequencies; and, the explanatory design is motivated to test hypothesis of causation. It must also be cross-sectional or longitudinal, explaining the timeframe needed to conduct the research (Neuman, 2007). The research devices used in science and the design established for data collection and analyses must produce the best result. It should also create avenues for replication and possibilities of falsification, since nothing is completely true in science (Okasha, 2002).

6. **Establishment of General Methodology:** A mature scientific discipline is dependent on a model that outlines what to study, how feasible the study is, and how accessible the object to be studied; what impact or relationship is assumed of the object to the social or physical world, and finally, what suitable methodology could be applied for the study in order to yield the best results (Kuhn, 1970). Choice of methodology justifies processes for test of assumptions and theories. Newton-Smith (1981) opined that scientific methodology equips scientists with reasons to accept or reject beliefs, hypotheses, theories or findings. General strategy or plan of action detailing the complete process of proposed research design; clarifications of choice on method; and technique that links choice of method to desired outcomes is the research methodology (Crotty, 1998). It is a general picture of the research that emerges from critical questions derived from the gained experience of the larger theories of social or physical phenomena. The entire research process is presented in methodology including plans and conduct in the field; study design; anticipated conclusions; and how to report findings. It highlights statements and clarifications of concepts, control of settings; attitudes and values; and context and contents of the research, respectively (Jonker & Pennik, 2010). Research methodology stretches analytical nature of study and demonstrates impartiality and reliability as it opens possibilities for replication.

7. **Formulation of Hypothesis:** Propositional issues are presented in science to serve as ideas for consideration and discussion among professionals. Guesses for answers to unresolved problems encourage formulation of hypothesis (Beissel-Durrant, 2004). Hypotheses are testable statements that show a relationship between variables. It determines the type of data to be collected, where to be collected, and how to be analyzed. Although not all scientific studies need a hypothesis, all studies need a guiding hypothesis or research question. Validated hypotheses form a base of new theory or theories.

8. **Selection of data collection method:** Some research has interdisciplinary and multidisciplinary scope (Beissel-Durrant, 2004). Therefore, several choices to use quantitative or qualitative method, primary or secondary source, or multi method triangulation exist. The selection is made in order to allow full observation and description of real occurrences of phenomena, because method is the process that connects methodology with observational unit and unit of analysis as it presents the specific steps together with applied logic to get the best and most comprehensive data, with elaboration of each technique used for data collection and analysis, (Johansson, 2004). Composition of method indicates procedures, actions, phases, chronology or the followed stringent sequence in research (Jonker & Pennik, 2010; Marczyk et.al, 2005; Kazdin, 1992). Parsimony is maintained through use of specific cases that relates to the problem as closely as possible and avoids use of unnecessary units (Ladyman, 2002). Intersubjective procedures are used in order to get that which is the most reliable of all. Research method is guided by the knowledge of the problem and its settings, and the explorations of methods used in previous studies (Jayaram, 2011). Also, four characteristics of replicability, falsifiability, precision, and parsimony distinguish science methods from other modes of explanations (Bhattacherjee, 2012; Okasha, 2002).

9. **Data Presentations and Analyses:** Collected qualitative or quantitative data determine means of presentation and analyses. Tabular presentations are most common while an in-depth analysis depends on level of measurement to which the variables belong. Basic levels of measurement applied in social sciences are nominal; ordinal; and interval/ratio levels. Social science researchers apply various statistical tests to validate collected data, processes and methods, and reach a final conclusion.

10. **Conclusions and Summary:** The method used in research is the element that judges the authenticity of final conclusion and it oscillates between theories, operationalizations or conceptualizations and observations (Dunne, et.al 2005). Comprehensiveness of reasons executes final verdict for recognition of truth. Truth reached through scientific method is termed ‘truth in the final instance’ because it rests on logical propositions that are real and commonsensical. Precise statements are summarized as new findings which are presented and reported with scholarly caution and restraint. A disclosure strategy is fully impartial and reflects progressive and innovative thoughts with expertise, liberty, and freedom (Furseth & Repstad, 2006). In a nutshell, the above format of scientific methodology preserves strong professional norms of honesty and uprightness, by placing value on merit in process and findings, not to any personal or individual character (Neuman, 2007). How are these processes shared between social and natural sciences?

Commonalities and Peculiarities of Natural and Social Sciences Methodology

All branches of science use similar methods, the unifying elements being the followed techniques but not the used materials. Categorizations and organizations of facts in any form or matter; careful observation of mutual relations; describing order of influence or arrangement is a scientific application (Pearson, 1957). Principles applied in research processes make it scientific, whilst different scientific disciplines have clear and agreed-upon guidelines for gathering, evaluating, and reporting data (Cozby, 1993).

Natural and physical sciences are fully influenced by the positivists' ideas. This philosophy views the purpose of scientific investigation as to describe phenomena and relate them to each other in order to allow generation of rules that enable calculation of probabilities of observations especially when the results of earlier observations are known. In this method, verifiable hypotheses are identified from the existentially quantified hypotheses and attempts are made to establish causations and present a law like statement since natural phenomena can be subjected to laboratory test and measurement. Part of the research culture of positivism is to see the text as in some sense neutral or almost naturally occurring. Application of positivist philosophy is limited in social science research since its use of experimentation method could not be done in absolutely controlled settings. Pure experimentation has limited applicability in social science (Bechhofer & Paterson, 2000) and as such, other methods like survey; case study; and action research methods are employed.

Phenomenological method is the most commonly applied philosophy in social science research. The method involves systematic investigation of consciousness, because it is the phenomenon that would prove a certainty of postulates. The central assumption is that, all experience of the world including perceptions of objects and the knowledge of mathematical formulae is constituted in, and influenced by consciousness. To study a phenomenon one must disregard all prior knowledge about the world, and address the question of how it emerges, why it emerges in that form, or from which matter or process does its knowledge come into being. This strategy is known as phenomenological reduction or referred to as bracketing (Ahmad, 2011; Scott & Marshall, 2005).

Materials and Methods for the study

Exploration of methodology and methods used by the Social Science students of Kelaniya University is the purpose of this study. The Social Science Faculty of this university consists of nine departments- Archeology; Economics; Geography; History; Library and Information Sciences; Mass Communication; Philosophy; Sociology; and Sports and Leisure Studies. Questionnaires with semi structured questions were used for data collection from a randomly selected sample of 120 final year undergraduates and postgraduate students. The method of interaction is self-administered since the

population composed of learned individuals. Also past student theses written in English were surveyed in the university library.

Presentation, Analysis and Discussion of Results

Collected quantitative data show that all the respondents (100%) demonstrate ignorance of scientific methodology and steps involved in it. On the alternative methods and steps used by the respondents, 63% (76) lamented having no specific format or steps. Only 37% (44) stated use of the questionnaire method or a combination of questionnaire and interview method as presented in Table 1 below.

Table 1: Students' Response on Knowledge and Usage of Scientific Methodology in Social Science Research

Variables	Responses			
	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Possessed knowledge of scientific inquiry	0	0	120	100
Used knowledge of scientific method in academic write up	0	0	120	100
Presented clear methodological steps in academic write up	44	37	76	63

Source: Field Work October 2012

In the qualitative data, the respondents mentioned that they never use scientific methods in academic research and writing and describe research as consulting books and internet materials. The techniques employed when using secondary sources and documents are not mentioned by the respondents as they cannot present the format or steps adopted in it. Observations of library materials indicate a good practice of scientific method with standard format by the students of Commerce and Management Faculty of the same university whose topics have much in common with that of social sciences.

Summary, Conclusion and Recommendations

Gebremedhin and Tweeten (1994) clarify that research methods and scientific writing techniques vary between persons, disciplines, and problems. Basic principles and mental techniques used in scientific investigation and communication of results in dissertations, theses and journal articles, or other forms are common (Beveridge, 1957). Rigid formula is used for all scientific discoveries or scientific writing with underlying basic assumptions that, events can be understood if right questions are

asked and right analyses are made; and, a systematic relationship always binds cause with effects. The checkpoints involved in scientific research basically comprise stating a problem; formulating a hypothesis or, clarifying research questions and developing objectives; designing method of data collection and analysis; interpreting results; and drawing conclusions. Courage, patience and unhurried activities lead to reliable findings as they help in overcoming disappointments or discouragements associated with pursuing answers to difficult questions. The research process is incomplete if systematic processes of reporting and disseminating results are not followed. Social science disciplines use scientific methods and the Social Science Faculty of Kelaniya University needs to develop, clarify, and standardize its methods for academic research and writing. Questionnaires are not methods; they are instruments used in the scientific research process to collect data.

References

Ahmad, H.I. (2011). Towards Understanding Social Phenomena in Contemporary Societies. In H.M. Bandara & K.R.H.L. Gunasekara (Eds.), *Essays in Social Sciences in Honour of Professor Dayananda Somasundara: Modelling Social Phenomenon in the 21st Century.* Colombo: Godage International Publishers.

Bacon, F. (1985). *The Essays*, edited by Pitcher, J. New York: Penguin.

Bauböck, R. (2008). Normative Political Theory and Empirical Research. In D.D. Porta & M. Keating (Eds.), *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective.* Cambridge: Cambridge University Press.

Bechhofer, F. & Paterson, L. (2000). *Principles of Research Design in the Social Sciences.* London: Routledge.

Beissel-Durrant, G. (2004). 'A Typology of Research Methods within Social Sciences.' National Centre for Research Methods (NCRM) Working Paper November, 2004.

Beveridge, W.I.B. (1957). *The Art of Scientific Investigation.* New York: Vintage.

Bhattacherjee, A. (2012). *Social Science Research: Principles, Methods and Practice.* Open Access Textbooks.

Cozby, P.C. (1993). *Methods in Behavioural Research.* Mountain View, CA: Mayfield.

Crotty, M. (1998). *Foundations of Social Research: Meaning and Perspective in the Research Process.* London: Sage.

Dampier, W.C. (1971). *A History of Science and its Relation with Philosophy and Religion,* [with a postscript by Cohen, I.B.]. Cambridge: Cambridge University Press.

Dunne, M., Pryor, J. & Yates, P. (2005). *Becoming a Researcher: A Research Companion for the Social Sciences.* Berkshire: Open University Press.

Furseth, I. & Repstad, P. (2006). *An Introduction to the Sociology of Religion: Classical and Contemporary Perspectives*. Aldershot Hants: Ashgate.

Gebremedhin, T.G. & Tweeten, L.G. (1994). *Research Methods and Communications in the Social Sciences.* London: Praeger.

Gomez, B. & Jones, J.P. (Eds.) (2010). *Research Methods in Geography: A Critical Introduction.* West Sussex: Wiley-Blackwell.

Hagstrom, W. (1965). *The Scientific Community.* New York: Basic Books.

Harre, R. (1967). *An Introduction to the Logic of Sciences.* London: Macmillan.

Hochberg, H. (2006). Verifiability. In S. Sarkar & J. Pfeifer (Eds.), *The Philosophy of Science: An Encyclopedia.* New York: Routledge.

Johansson, R. (2004). Theory of Science and Research Methodology. Retrieved October 04, 2012, from www.infra.kth.se/bba/bbasvenska/larger2/1u1030%20LectureNotespdf.

Jayaram (2011). *Diversities in the Indian Diaspora: Nature, Implications, Responses.* Oxford: Oxford University Press.

Jonker, J. & Pennink, B. (2010). *The Essence of Research Methodology: A Concise Guide for Master and PhD Students in Management Science.* London: Springer.

Kantorovich, A. (1993). *Scientific Discovery.* Albany, NY: State University of New York Press.

Kazdin, A.E. (1992). *Research Design in Clinical Psychology.* Boston: Allyn and Bacon.

Kitcher, P. (1993). *The Advancement of Science.* New York: Oxford University Press.

Kuhn, T. (1970). *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Ladyman, J. (2002). *Understanding Philosophy of Science.* London: Routledge.

Laudan, L. (1990). *Science and Relativism.* Chicago: University of Chicago Press.

Longino, H. (1990). *Science as Social Knowledge.* Princeton NJ: Princeton University.

Marczyk, G., DeMatteo, D. & Festinger, D. (2005). *Essentials of Research Design and Methodology.* New Jersey: John Wiley.

Merton, R.K. (1973). *The Sociology of Science.* Chicago: Chicago University Press.

Mulkay, M.J. (1991). *Sociology of Science,* Philadelphia: Open University Press.

Nagel, J. (2006). Empericism. In S. Sarkar & Pfeifer, J. (Eds.), *The Philosophy of Science: An Encyclopedia.* New York: Routledge.

Neuman, W.L. (2007). *Basics of Social Research: Qualitative and Quantitative Approaches*. Boston: Pearson Education.

Newton-Smith, W. (1981). *The Rationality of Science.* London: Routledge and Kegan Paul.

Okasha, S. (2002). *Philosophy of Science: A Very Short Introduction.* Oxford: Oxford University Press.

Pearson, K. (1957). *The Grammar of Science Part I.* New York: Meridian Books.

Popper, K. (1959). *The Logic of Scientific Discovery.* London: Routledge.

Psillos, S. (1999). *Scientific Realism: How Science Tracks Truth.* London: Routledge.

Resnik, D.B. (1998). *The Ethics of Science: An Introduction.* London: Routledge.

Scott, J. & Marshall, G. (Eds.) (2005). *Oxford Dictionary of Sociology.* Oxford: Oxford University Press.

Walliman, N. (2006). *Social Research Methods.* London: Sage.