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Scientific Explanation of Natural and Social Sciences and Their Contributions in the Development of Knowledge: Are They Similar or Different?

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ABSTRACT

It is a general believe that science is based on facts and figures. The observations of individuals about the construction of world and its particles are put into experiments and when proved, are treated as science. On the other hand, there is a field of social science which has the credit to observe the society and its practices. From individual life to society as a whole, public to government, crime to law, politics to economics, sociology to psychology and so on. This paper presents the Scientific Explanation of Natural and Social Sciences and their Contributions in the Development of Knowledge. The article takes a critical look at the similarities and differences based on methods of research in natural and social sciences, their branches, criticisms on approaches used and their contributions towards the creation and development of knowledge. It was found that the two fields, natural and social sciences are different from each other in terms of definitions, origin,

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branches, methods of investigation, contributions in the creation of knowledge as well as criticisms made on both fields. Thus it was concluded that while natural sciences uses more of quantitative techniques of investigation and the interpretations anchored on objectivity, the social sciences uses more of qualitative techniques and the interpretation is highly subjective. Hence results produced in natural sciences could be considered more reliable than the social sciences.

Keywords: Natural sciences; social sciences; definitions of natural and social sciences; branches; methods of investigation; criticism on approaches; contribution towards knowledge creation.

1. INTRODUCTION

It is a general believe that science is based on facts and figures. The observations of individuals about the construction of world and its particles are put into experiments and when proved are treated as science. The laws and theories of natural sciences are the result of such observations and experiments. Newton's (1643-1727) law of motion/gravity and Galileo's (1564-1642) achievements in the field of astronomy are the result of their observations and then experimentation. All these experiments are conducted under the huge tree of natural sciences having many branches. However, three main fields of natural sciences are Biology, Chemistry and Physics.

On the other hand there is a field of social sciences which has the credit to observe the society and its practices. From individual life to society as a whole, public to government, crime to law, politics to economics and from sociology to psychology, are the major field of social sciences. The contribution of social sciences is not less than the natural sciences. Even though social sciences cannot produce the theories and laws which uncover and predict the foundation of universe, it is still producing some valuable knowledge, such as mutually beneficial social norms for societies. The natural sciences are able to provide a solid consent about any theory, if it is valid or invalid. This quality of natural science compels many researchers in the field of social sciences to think, if they can import the scientific methods of natural science to study the social world. However, still in 21st century the debate on the contribution of two sides is at top. This study attempts to answer the following two questions.

1. How to differentiate social sciences from natural sciences?
2. How scientific methods of natural sciences can be used to prove the theories of social sciences?

The objective of this study is not to prove if natural sciences are good and social sciences are bad or which is serving the society more, natural sciences or social sciences. This study will be a simple comparison of natural and social sciences, their similarities and differences.

The study will try to distinguish both fields of science by presenting their definition, origin and investigation methods. Different approaches used by natural and social sciences to discover new knowledge will also be discussed in the later part of this paper.

The natural and social sciences are the same in many aspects and different in many ways. The similarities include the use of common methodologies and overlapping epistemological and ontological stances which includes the point of views about the creation of knowledge and the nature of reality. However, the two fields are also different as per the subject of study, origin, limitations and delimitations.

According to Okasha [1], it is very difficult to find the features which can differentiate the science from other fields used to understand the world like religion, fortune telling and astrology which are not treated as the fields of natural science. The authors like [2] and [3] argue that natural and social, both are real sciences [4]. Further divides real sciences into two categories, applied sciences and literary studies. Applied sciences include engineering and medicine. It is a fact that without the contribution of social sciences, people will have to rely on folk wisdom and ancient sketches to understand the social world. Unfortunately, both are not reliable. So, despite the differences of definition, origin, methods, and subject of study, both natural sciences and social sciences are contributing their part in the creation of knowledge.

2. NATURAL SCIENCE DEFINITION

Natural Science is a branch of science which deals with describing, predicting and

understanding the natural phenomena, which should be based on observations and empirical evidences. According to Stephen [5], “natural science is a discipline which deals with natural events (i.e.; independent and dependent variables in nature) using scientific methods.” It is generally believed that science is the only field which uses scientific methods but in 21st century different field of study are trying to adopt scientific methods of investigation to produce more logical and rigorous results. According to [6], “Science does not purvey absolute truth, science is a mechanism. It’s a way of trying to improve your knowledge of nature; it’s a system for testing your thoughts against the universe and seeing whether they match.” So, the definition given by Asimov is also based on two basic points. One, it is a knowledge of nature and second, it is all about testing the observational thoughts to find their accuracy. If we look at the origin of science this point is very much clear that science took its start from observations and then came the experimentation stage. This quality of experimentation differentiates science from other fields of studies. Natural sciences enjoy the laboratory setting and contrived environment to test different observations on the basis of their results, we see many theories prevailing in the world of science. While, other fields of studies are unable to enjoy such contrived environment yet, so, uncontrived environment and unavailability of laboratory settings make the results more subjective and unreliable to some extent.

2.1 BRANCHES OF NATURAL SCIENCES

The main branches of natural science are Physics, Biology and Chemistry. Whenever a common person listens the word “Science” he/she believes that it is something from these three fields. However, according to Karl [7], natural sciences have three other great branches stating that “Aside from the logical and mathematical sciences, there are three great branches of natural science which stand apart by reason of the variety of far reaching deductions drawn from a small number of primary postulates — they are mechanics, electrodynamics, and thermodynamics.”

In the 21st century the division of natural sciences is based on three categories, life science, material science, and physical science. Life science includes the field such as zoology, biology and botany. Physical science has the major fields like chemistry, physics and

astronomy and last but not the least material sciences has the field; engineering and industrial products, metallurgy and mineralogy.

2.2 ORIGIN OF NATURAL SCIENCES

The origin of natural sciences can be traced in early pre-literate human social settings. The understanding of nature and the world was necessary for the survival of humans. That understanding provided a base to understand the behaviour of animals and the use of plants as medicines and especially for food. The same has reached to us, by passing from generation to generation [8]. The early formal written evidence “natural philosophy” can be found in the Ancient Egyptian society around 3500 BC. The natural philosophy is the base of natural science [8]. However in the writings about the origin of science [8], argued that the purpose of inquiry about nature in the early ages was more religious and mythological, not scientific.

The belief of Chinese ancient society, that the world is a combination of five forces, fire, water, wood, earth and metal can also be treated as the start of natural sciences. They had the predefined cycle combining these forces, like water converts into wood, wood to fire, fire to ashes and ash was considered as the base of world [9]. Using this, Chinese philosophers and doctors found the relationship between pulse, heart and flow of blood in the human body [9]. It was accepted by the Western world some hundred years later.

So, we can say that science is as old as the humans on earth because the observation about nature and its elements took start with the start of life on earth. The early humans had no facilities to test their observations in the laboratories with contrived and controlled environment; however their observations and experiments in natural environment gave birth to the field of science. Same observation is the fundamental element of today’s natural science.

2.3 INVESTIGATION METHODS IN NATURAL SCIENCES

The use of methods in natural sciences mainly depends on the type of problem to be investigated. However, Natural sciences always prefer to use the methods which can produce reliable and concrete results. All the investigation done so far under the huge umbrella of natural sciences has used quantifiable methods which

has produced rigorous results. The advantage which natural sciences have over the other fields of studies is the use of laboratory setting where the environment can be controlled to have the precise results. In other words, natural sciences results are objective in nature. The methods are based on contrived environment and engage lot of mathematics. That is why they are called quantitative methods of investigation. Generally methods start from observation which leads to the development of hypothesis and at the end experiments are conducted to prove the hypothesis. If the results are matching the hypothesis, they are accepted otherwise rejected. Confinement and purification in the results of any experiment are common and ongoing practices in natural sciences. Theories and models are only relied after a continuous successful achievement of their objectives. Investigation methods in different field are different like in physics and chemistry most of the experiments are done in laboratory settings while in Biology many experiments are also conducted in natural environment and not contrived settings.

2.4 CONTRIBUTION OF NATURAL SCIENCES IN KNOWLEDGE DEVELOPMENT

Natural sciences have contributed some very solid and reliable techniques to enhance the body of knowledge. It was Galileo who started the scientific methods to acquire the knowledge some 400 years ago when he conducted an experiment to test his hypothesis. His approach is still followed in modern scientific research; identifying problem, collect necessary data, develop hypothesis, test the hypothesis, and draw a conclusion which further leads to the development of theory and ultimately it becomes a law. So, natural science is the pioneer field which led down the foundation to acquire concrete and evidence based knowledge, not personal beliefs. Many modern scientists also follow the guidelines of Aristotle to develop the new knowledge; his famous saying "Conclusions can only be reached by discussion and logic" has a great importance in scientific research to acquire new knowledge.

However, all the inventions and innovations in natural sciences are not the result of scientific methods. In fact some inventions are purely accidental.

2.5 CRITICISM ON NATURAL SCIENCES

The main criticism on acquiring knowledge with the help of scientific methods was made by Karl [10], in 1960s. The unique point was in favour of "falsification" of theories and laws. According to Karl [10], "nothing that cannot be falsified can be called a scientific hypothesis/theory". Before [10], there were not many scientists who criticised the methods of acquiring knowledge. The general practice of inductive epistemology was used and accepted by the scientists, in which findings were accepted and treated as general truth when a reasonable number of experiments have the same outcome. Criticised this practice and said "a theory cannot be confirmed by induction, but only falsified by a simple observation [11].

Many researchers still ask one question, are the scientific methods flawless? The answer is no, although the scientific methods are more reliable and element of objectivity dominates in these methods but still these are not purely error free.

3. SOCIAL SCIENCES DEFINITION

Social science is a study of society and its institutions at large, its functions and the relationship among its individuals is discussed in detail. The detailed definition of social sciences by European Scientific Foundation is given below.

"The social sciences which encompass sociology, politics, economics, law, education, business studies, town planning and many others – "examine and explain human functioning on a variety of interlocking levels, ranging from neural foundations to individual behaviour, group processes and the functioning of entire societies." [12].

Auguste Comte (1798-1857) was the first philosopher to use the term "science sociale" to refer the field of social sciences. The term was taken from the ideas of Charles Fourier (1772-1837), Comte also used the words "Social Physics" to describe this field [13].

The term social sciences got the attention of scholars and researchers in the 19th century. Different scholars have defined it in different words but there seems a consensus among the scholars that social sciences is relevant to the study of social settings, behaviours of individuals

in society, their economy, and society itself at large.

3.1 BRANCHES OF SOCIAL SCIENCES

The branches of social sciences are as many as one can think. Generally, whatever disciplines are beyond the field of natural sciences are called the discipline of social sciences. However, the main disciplines of social sciences are Economics, Law, Political Science, Sociology, Religion, Psychology, Linguistics, Education, History and Communication Studies.

Among all the aforementioned fields, Economics is given the most importance in social sciences because it is one of the oldest fields of study. Many administrative sciences of the modern age were the part of economics in the past. Many new fields are still emerging in this discipline and becoming the part of social sciences in the 21st century.

3.2 ORIGIN OF SOCIAL SCIENCES

The origin of social sciences can be traced out in the age of enlightenment, 1650, with the revolution in natural philosophy. However, the field of social science is very young compared to natural science. The major breakthrough was made in this field during the 19th century with the contribution of Emile Durkheim (1858-1917) and Comte (1798-1857). The sociological publication "suicide (1897)" by Emile Durkheim and the concept of "Positivism" by Comte led the foundation of modern social sciences research. The work of Karl Popper (1902-1994) in the 20th century has proved the importance of social sciences in academia. Popper is regarded as one of the most influential philosophers of the 20th century. His famous theory of "Falsification" got the attention of researchers which have changed the methods of research all together.

3.3 INVESTIGATION METHODS IN SOCIAL SCIENCES

The methods of investigation in social sciences are different from natural sciences if not totally opposite. The reason of differentiation is control over environment. As discussed earlier, natural sciences enjoy the contrived environment while social sciences work in non-contrived environment. The use of experiments is common practice in natural sciences while observation

and subjective interpretation dominates the research in the social sciences field. Social sciences are trying to adopt the methods of natural sciences to judge the society, individuals, and institutions. The social scientists believe that, if reason and laws can be used to understand the world, reasons and science can also be used to understand the society, humans and their unique behaviour. However, the use of scientific methods is not very common in social sciences because it is very difficult to control the research environment and unique behaviour of humans, if not impossible. The laboratory experiments are used in the field of behavioural economics and social psychology, but their results are not overwhelming. The most important and commonly used methods in social sciences are interviews, case studies and surveys.

3.4 CONTRIBUTION OF SOCIAL SCIENCES IN KNOWLEDGE DEVELOPMENT

The contribution of social sciences in the development of knowledge is very vital which cannot be denied at any forum. The research in social sciences has guided the "Dark Age" society to the 21st century society which is much better for the human life. It is social science which guides the governments, how to constitute good institutions to make the public life better. The research in the field of economics has produced some very fruitful results in form of budgeting, monetary and fiscal guidelines to the governments through which the can increase the efficiency of their spending.

The research in other fields of social sciences is also facilitating the individuals in society. The use of ethics in behaviours has changed the society to a peaceful planet. The large databases of history, geography, sociology, political science, religion and economics will serve the coming generations to live a better life.

However, the quality of knowledge produced by the social sciences is questionable. It is really difficult to differentiate between good knowledge and bad knowledge in social sciences. Excessive use of subjective interpretation in social sciences has made its knowledge doubtful.

3.5 CRITICISM ON SOCIAL SCIENCES

The major criticism on social sciences is made by the researchers and scientists, when they

compare the benefits of social sciences and natural sciences. The main arguments held by the social scientists are regarding the benefits to society provided by the social sciences. On the other hand, the critics still believe that in terms of benefits, social sciences still lag behind engineering, medicine and ultimately natural sciences. According to Roberto [14], "they have degenerated into pseudo-science". "Social sciences have severed the link between insight into what exists and imagination of what might exist at the next steps – the adjacent possible".

Bergman [15] argued "Though quantitative methods may rule economics, political science and psychology, these disciplines can never achieve the objectivity of the natural sciences. Those who study social behaviour or fund studies of it are inevitably influenced by value judgments, left, right and centre. And unlike hypotheses in the hard sciences, hypotheses about society usually can't be proven or disproven by experimentation. Society is not a laboratory"

The critics argue that all the benefits to society by the social sciences are theoretical or they cannot be evaluated practically like inform of patents, gadgets or pharmaceutical products by the natural sciences.

The direct benefit to society by the social sciences is not very noticeable. So, the major critics raise the question such as, "if the immediate or direct benefit to society cannot be demonstrated by the social sciences, why should society fund a research project of this field". The advocates of social sciences argue that research projects conducted by their field actually guide the society and point out the sectors which need improvement and attention. The reforms in the fields such as (law, economic policies, political affairs and religious issues) for better future cannot be implemented without the help and guidelines of social sciences.

4. ECONOMICS AND THE USE OF SCIENTIFIC METHODS

Before the start of experimental work by Vernon L. Smith and other experimentalists, economics was considered as the science of observations like other social science subjects like sociology, history etc. Nowadays many economists have

turned their attention towards the experimental economics and from the last two decades the experimental work has been accelerated. The most important areas which are influenced by experimental economics are game theory and theory of consumer choice. Different areas of public finance, resource economics, labour economics & finance and industrial organization are the part of experimental economics nowadays.

Edward [16] took the initiative to use the market experiments in the context of market imperfection. The career of Vernon Smith in experimental economics was started with the study of competitive market. His idea of double-oral auction scheme to the price formation was his start in the field of experimental economics. The double oral auction scheme was experiment which he conducted with his students was a simple idea of bid and offer prices with a facility of auctioneer who was responsible to recognize and record the bid and offer transactions accepted. In his experiment new days start with the same value for buyer and the same cost for seller. Because market participants have the complete knowledge of their previous outcome so—they can adjust their expectations accordingly.

Vernon Smith established a computer laboratory at university of Arizona in the 1970s for experiments. Williams and Vernon [17] found that double oral auction results in competitive equilibrium. The variation in that competitive equilibrium in shape of demand and supply curve is also strong. They also found that competitive equilibrium can be achieved even with very small number of agents which means that theory of demand and supply application is far away from the conventional economics theory.

Walras presented a simultaneous auction tatonnement mechanism that matches supply and demand in perfect competition as an alternative to Vernon Smith continuous double auction mechanism. However Williams and Vernon [17] found through his experiments that in the presences of variation in demand and supply forces and multiple transactions, double oral auctions works better than tatonnement mechanism found by Walras. He also argued that institutions matters.

Table 1. Summary of the study

S/No	Natural sciences	Social sciences
1. Definition	A branch of science which deals with describing, predicting and understanding the natural phenomena, which should be based on observations and empirical evidences. According to [5]. "natural science is a discipline which deals with natural events (i.e. independent and dependent variables in nature) using scientific methods."	The social sciences which encompass sociology, politics, economics, law, education, business studies, town planning and many others – "examine and explain human functioning on a variety of interlocking levels, ranging from neural foundations to individual behaviour, group processes and the functioning of entire societies" [12].
2. Branches	The main branches of natural science are Physics, Biology and Chemistry. According to [7]. the main branches of natural science are mechanics, electrodynamics, and thermodynamics."	The main disciplines of social sciences are Economics, Law, Political Science, Sociology, Religion, Psychology Physiology, Linguistics, education, History and Communication Studies.
3. Origin	The early formal written evidence "natural philosophy" can be found in the Ancient Egyptian society around (3500) BC. The natural philosophy is the base of natural science [8]. However in his writings about origin of science [8]. argues that the purpose of inquiry about nature in the early ages was more religious and mythological, not scientific.	Origin of social sciences can be traced out in the age of enlightenment, 1650 with the revolution in natural philosophy. However, field of social science is very young compare to natural science. The major breakthrough was made in this field during 19th century with the contribution of Emile Durkheim (1858-1917) and Comte (1798-1857).
4. Methods of Investigation	The use of investigation methods in natural sciences mainly depend on the type of problem to be investigated. However, Natural sciences always prefer to use the methods which can produce reliable and concrete results. All the investigation done so far under the huge umbrella of natural sciences has used quantifiable methods which has produced rigours results. The advantage which natural sciences have over the other fields of studies is use of laboratory setting where the environment can be controlled to have the precise results. In other words, natural sciences results are objective in nature.	The methods of investigation in social sciences are different from natural sciences if not totally opposite. The reason of differentiation is control over environment. Social sciences are trying to adopt the methods of natural sciences to judge the society, individuals, and institutions. The social scientists believe that, if reason and laws can be used to understand the world, reasons and science can also be used to understand the society, humans and their unique behaviour. However, The most important and commonly used methods in social sciences are interviews, case studies and surveys
5. Contribution	Natural sciences have contributed some very solid and reliable techniques to enhance the body of knowledge. It was Galileo who started the scientific methods to acquire the knowledge 400 years ago when he conducted an experiment to test his hypothesis. His approach is still followed in modern scientific research i.e.; identifying problem, collect necessary data, develop hypothesis, test the hypothesis, and draw a conclusion which further leads to the development of theory and ultimately it becomes a law.	The research in social sciences has guided the "Dark Age" society to the 21st century society which is much better for the human life. It is social science which guides the governments, how to constitute good institutions to make the public life better. The research in the field of economics has produced some very fruitful results in form of budgeting, monetary and fiscal guidelines to the governments. The use of ethics in behaviours has changed the society to a peaceful planet. The large databases of history, geography, sociology, political science, religion and economics will serve the coming generations to live a better life.
6. Criticism	The main criticism on acquiring knowledge with the help of scientific methods was made by Karl Popper in 1960s. His point was really unique as he was in favour of "falsification" of theories and laws. According to him "anything that cannot be falsified can be a scientific hypothesis/theory". The Karl Popper criticized this practice and said "a theory cannot be confirmed by induction, but only falsified by a simple observation. Many researchers still ask one question, are the scientific methods flawless? The answer is no.	The major criticism on social sciences is made by the researchers and scientists, when they compare the benefits of social sciences and natural sciences. The critics still believe that in terms of benefits, social sciences is still lag behind engineering, medicine and ultimately natural sciences. So, the major critics raise the question such as, "if the immediate or direct benefit to society cannot be demonstrated by the social sciences, why should society fund a research project of this field".

The current researchers in experimental economics are highly influenced by Williams and Vernon [17] work. Williams and Vernon [17] also introduces the laboratory experiments for actual monetary payoffs. They stressed that sufficient monetary rewards should be used to ensure that objectives of subject and investigator are same.

So, unlike other social sciences fields' economics is the one using scientific methods like natural sciences but the use of these methods is very limited and still incorporates the subjective interpretation.

5. CONCLUSION

The two fields, natural sciences and social sciences are different from each other in respect to their definitions, origin, branches, methods of investigation, contributions in the creation of knowledge and even criticism made on both fields has different base and stand points. The natural sciences are using more quantitative techniques of investigation and there interpretation is based on objectivity. While, the social sciences are using more qualitative techniques and the interpretation is highly subjective. So, results produced in natural sciences are considered more reliable than the social sciences. The social scientists are trying hard to adopt the scientific methods of investigation to ensure the concrete and rigorous result in their field. The proof of their effort is the use of scientific based laboratory experiments in the field of Economics. This effort will not only produce more reliable and valuable results but it will bring two fields really near where they will have the chance to enjoy more cooperation instead of more criticism on each other's methods. The use of different methods makes the two subjects different in their investigation approach, but the contribution of both fields is highly appreciable in the creation of knowledge.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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