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The Impact of Culture on Scientific Development

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Abstract

Scientific development in societies of the world is not even. Some societies are more developed scientifically than others. There are many possible reasons that could be offered to explain this. This work aimed at unravelling the role cultures play in the growth of science. The research uses creative philosophical analysis to arrive at the conclusion that most countries in spite of parading the same educational curriculum like their counterparts remain dwarfs scientifically. The difference in scientific development as discovered by these researchers is traceable to differences in culture. Though, culture greatly impact on science, it is also discovered that the level of scientific growth also determines how fast a culture would evolve. It implies that the two concepts have impacts on the development of each other.

Keywords: science, culture, interrelationship, cause and effect, funding.

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1. Introduction

Culture is a derivative of the Latin term - cultura meaning "cultivation"[1]. Etymologically therefore, culture connotes a process of cultivation or improvement. This was its usage until the 19th century, when the term developed to refer first to the betterment or refinement of the individual, and later to the fulfilment of national aspiration or ideals. In the mid-19th century, some scientists used the term "culture" to refer to a universal human capacity [2]. Today culture is generally known as a way of life of a particular society. It is a complex system of behaviour, values, beliefs, traditions and artefacts, which is transmitted through generations. According to Batista Mondin “culture signifies the totality of custom, techniques, and values that distinguish a social group, a tribe, a people, a nation” [3]. Culture encompasses various aspects of communications, attitudes, etiquettes, beliefs, values, customs, norms, foods, arts, jewelleries, clothing styles, etc. It is therefore, any behaviour that is learned and not innate in an individual. It is culture that distinguishes a French man from a Spaniard, an Igbo from a Yoruba, an Italian from an American. Culture is therefore, all those learned behaviours that characterise a particular society. It is learned from the people in the surrounding environment: parents, guardians, relatives, etc. These beliefs, values, traditions and behaviours are passed down through generations. Aspects of human culture include: Language and dialect, religion, cuisine, Aesthetics, art, music, literature, fashion, and architecture, values, ideology, Social conventions, including norms, taboos, and etiquette, gender roles, recreational activities such as festivals and holidays, commercial practices, social structure et cetera.

Science is a term derived from the Latin word *scientia*, meaning "knowledge." It is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the world [4]. Science also refers to a body of knowledge itself, that is, a type that can be rationally explained and reliably applied. Science has been closely linked to philosophy since classical times. In the early modern period the words "science" and "philosophy" were oftentimes used interchangeably. However, by the 17th century, natural philosophy (which is today called "natural science") became a separate discipline. [5]. After the separation "science" continued to

be used in a broad sense denoting reliable knowledge about a topic, in the same way it is still used in modern terms such as, Library science, Agricultural science, Social science or Political Science. However, in modern use, "science" is "often treated as synonymous with natural and physical science, and thus restricted to those branches of study that relate to the phenomena of the material universe and their laws, sometimes with implied exclusion of pure mathematics. This is the sense in which science is understood in this work. In this modern usage according to Richter, science came to be association with a distinctive view of nature as operating according to general laws which remain hidden under ordinary observational circumstances but which can be uncovered through systematically controlled observation and experiments [6].

There is seemingly an invincible connection between culture and science, for as the society and its culture unfolds, so also would science. The growth and progress of science in an area depends on the culture of the given area. The science in a society that throws all causal explanations to the transcendental may not match the growth of science in a society where all such explanations are attributed to empirical causes. The cultures that explain everything in terms of the transcendental would less likely make an empirical (scientific) investigation of such causes [7]. This is because such causes are believed to be out of the reach of empirical investigation, only individuals with special spiritual gifts could transcend such horizon. Science being an empirical activity grows and flourishes in a culture that is empirically minded. The level of civilization, income and demands of a society amidst other factors, also determines the rate of growth of science in a given region. This research investigates this impacts of culture on science with the aim of showing why some countries are more advanced scientifically than others.

2. The impact of Culture on Science

Science is undoubtedly part of culture since it is a learned activity. Thus, how science is done largely depends on the culture in which it is practised. There is therefore, certainly an imprint of culture on every scientific activity. This implies that careful examination of any scientific activity would reveal the culture of the particular scientist or group of scientist carrying out the scientific activity. Below are the ways the culture of a given society imprints or puts it marks on the activities of science and scientists.

3. Cultural Beliefs and Goals Imprint on Science

The cultural beliefs which humans are born into exert a measurable influence on their lifestyles. Culture shapes goals, beliefs and values one holds. Scientists being humans, are also affected by culture. The beliefs and culture he imbibes from the society influence to a large extent, his/her participation in a research. The case of Joseph Rotblat is a good example. In 1939, Joseph Rotblat was among the first scientists to discover that the splitting of atoms could release great energy (atomic bomb) that could be destructive. However, instead of being excited by the discovery, he decided not to involve in the research that would produce it, because of its potential threats to lives. His beliefs in the sanctity of life, shaped his decisions. Unfortunately, Rotblat lost his wife to the Germans, due to the Nazi invasion. This brought a twist in his beliefs necessitating him to join in the research that produced the atomic bomb. This turnaround was motivated by a change in belief. He feared that the Germans could discover and develop its own atomic bomb, which will spell doom for many humans. This belief that atomic bomb could deter the Germans and possibly stopped the war, influenced him into moving to the United States to help the Manhattan Project to develop an atomic bomb.

However, in 1944, Rotblat learned that German scientists had abandoned their research on atomic weapons. This brought another shift in the life of Rotlab, for it no longer seemed likely that the bomb which he was helping to develop would be used merely for deterrent purposes. In 1944, Rotblat became the only scientist to resign from the Manhattan Project - because he found its probable application unethical. After World War II, Rotblatchannelledhis physics towards medical applications and in 1995 won the Nobel Peace Prize for his efforts towards nuclear non-proliferation [8].

Rotblat chose a particular area of research because of the influence of his cultural beliefs and ethical views; other scientists too have chosen and continue to choose research topics based on their cultural values or political commitments. Societal beliefs, values and goals therefore direct scientific research in a particular direction. They profoundly influence what topics scientists choose to study. Thus what scientists eventually choose to study, agrees with their cultural ideals. Any scientific research that flourishes in an area carries with it the cultural ideals of that society. Without these cultural marks on it, it will not flourish, because it will lack support. The success of any scientific research therefore largely depends on the agreeability of the research with the cultural ideals of the surrounding society.

4. Societal Demands Drive Scientific Research

The demands of a particular culture imprints on the science of the day. It is a common saying that every philosophy is a child of its age. Every science too is a child of its age. Thus, the demands and needs of a particular community shape the scientific research in that culture. In

war time for instance, science would tilt towards research on weapons of warfare because that represents the greatest demand at that moment. In time of peace, the focus of science on weapons of warfare would shift to other things. The rate and quantity of demand would determine the direction of growth of science. The more the demand of a certain product, the more scientists would be researching on it, in order to improve its production. A fall in demand too would have a negative effect on the development of science in that field. In 1856 for instance, while trying to make quinine, the chemist William Perkin stumbled upon a dye which produced a new colour, called mauve. The colour was an instant hit. It adorned women across Europe and became a cash cow for the inventor. This cash made by William Perkin attracted other chemists; springing forth the field of organic chemistry, fired by a fashion craze [9]. The demands of society therefore, may sometimes seem frivolous and trivial; yet, it could change the course of science in that area.

Since the culture of every society is continually unfolding, science too is continually unfolding. The direction of its movement reflects the direction of movement of culture. For society and culture cannot be at loggerhead, culture would always bend science although in some instances as shall be discussed later, science too could bend culture. But whatever happens science and culture would always flow at the same current.

5. The Level of Income of a Society and its Spending trend shapes science

While some sciences can be done with little or no money at all, some can be very expensive. For instance, one can do good scientific research on the fowl in his/her backyard or on a shoestring or a cassava stem, at almost no cost. However, many research topics in science are not so cheap. For example, scientists spend billions of dollars to develop particle accelerator, space ships, atomic bombs et cetera.

Science therefore, can be very expensive. Money need to be available for payment of salaries; purchase of lab equipment, setting up of a workspace, and financing of field research. Without funding, science as a whole simply cannot progress. Funding of science however, most times comes from the societies that will reap its benefits. Poor societies would definitely not be able to fund expensive research. Even a society that is rich may not support scientific research depending on their spending trend. Some societies especially the consumerist minded ones, see billions of dollars spent on research as abhorrent and waste of money. Funding of research is a form of risk-taking and only a society that is tilted towards risk-taking would sponsor scientific research. Societies therefore, especially in developed countries help determine how their money is spent and only research that they like would be sponsored. For example, a culture that largely approves of stem cell research will sponsor it or encourage government support and thereby, stimulating advances in the field. However, a society that largely disapproves of stem cell research is unlikely to fund such a venture and will discourage politicians who provide funding for that research. In this case, research on stem cells will not be done, thereby inhibiting growth of this scientific field. Thus, looking at the scientific research in an area would determine what the culture supports and what the culture does not. Cultural beliefs therefore drive scientific research through funding of the research. The extent of funding also reveals the extent of civilization of a culture. Science cannot rise above the knowledge level of its surrounding community. For instance, it would take an enlightened society to fund scientific research on carbon dioxide mitigation. The funding of a research on the mating habit of snails would be greeted with mixed reactions in different societies depending on their knowledge level.

The extent of funding of a scientific research also bears the mark of a society income level and society's interest. Income level of every society fluctuates. Funding available for a research at a particular time determines the income level of the society at that time. Thus, scientific research would fluctuate along with the fluctuating income of the society. When the income level is high, the level of funding would also be high, and when income level is low, the level of funding would also reduce accordingly. Funding available for scientific research also depends on societal interest. For instance, a society's interest in curbing pollution and conserving their natural resources would determine the extent of funding of these researches.

Societal funding therefore influences the path of science by encouraging research on some topics and pointing them away from others. The amount of money available in a society and its spending culture would imprint on the scientific research on an area. If a given society does not see science as a value, the spending towards scientific research would be minimal and the reverse is also true [10]. This explains why some countries like the Western cultures spend more money in scientific research than other countries. Some countries like Nigeria spend less in science because of their cultural beliefs that tend to explain almost everything in terms of the supernatural – thus leaving little or no room for empirical investigation [11]. This is why science is still at an infant stage in this country. The cultural beliefs and values retard its growth.

6. Science gathers Inspiration from the Cultural Beliefs and Ideas in the Society

Societal interactions encourage innovation and spark ideas in the minds of scientists; it raises new problems, assumptions, new applications, new questions, new evidence, new hypothesis and new explanations in their minds. The idea of Copernicus on the movement of planetary bodies for instance, did not come out of the blue. The idea was sparked by ideas and beliefs of many other scientists like Philolaus, Aristarchus, Aristotle, Ptlolemy, Buridan, Nicholas of Oreme, Nicholas of Cusaetc [12]

Provision of inspiration to scientists is therefore, another way the culture of a given community imprint on scientific development. A society where such ideas are lacking would not experience much growth in science, because science grows from the ideas in its environment. Classical mechanics for instance grew from Aristotelianism; the relative theories of Einstein on the other hand grew from classical mechanics, and quantum mechanics grew from the relative theory – the unity theory is now shooting off from the quantum mechanics. Without prior ideas in the environment some theories may not have developed. Without prior ideas of Parminides, Zeno, Euclid, Plato, Aristotle, Newton etc on space and time, Albert Einstein theories of relativity may not have developed.

7. Culture provides the fire that fuels Scientific Research

People are generally spurred up by competition. Students would study harder for exams; musicians would perform better in a stage; actors and actresses would put in their best performances; politicians would campaign harder when there is competition. The stronger the competition, the greater would be the amount of time and energy invested in these ventures. This is also true about Scientists. Most scientists are motivated by the competition offered by the community. Competitive culture of a society therefore, fuels scientific research. Scientists are well aware of the respect their peers would accord them, if they make breakthroughs in their research. This expected recognition and respect from peers as well as the community would spur up scientists to research more intensely. The more the competition, the more scientists would work harder. The consciousness that their peers may get this breakthrough before them would energize them to work harder and faster. This happened in the 1980s. Scientists set out to record the DNA sequence of the three billion or so base pairs that make up the human genome. In 1990, the publicly funded Human Genome Project (HGP) began its work in earnest, using a tried and true sequencing technique that begins with a map of genetic landmarks on each chromosome. This research was however challenged in 1998, by a private company, Celera. Celera proposed to decode the genome using a new so-called shotgun technique that did not require an initial landmark map - and to complete its work in just three years, four years before the HGP would complete their sequence. This competition inspired the HGP to accelerate their work and move their target completion date up to rival Celera's. In the end, this rivalry propelled both efforts forward. Both teams published their working drafts of the genome ahead of schedule in February of 2001 - and when they did, the private team's paper had more than 100 authors and the HGP's had more than 1000 [13].. Provision of competition is therefore one way in which culture imprint on science.

In science therefore, both competition and recognition from the community encourage and instigate scientists to test a new idea, engage in creative thinking, and work harder. The society most often, provides this competition. The realization that other people are working or might be working on the same project could and do speed up scientific research. A society that lacks interest in science may not actually be able to provide this important fuel for scientific development. This is perhaps one reason why the West, is on higher speed in scientific development than some other countries, even when every country claims to be aware of the importance of science to the development of the society. The challenge as well as the motivation is lacking in some of these cultures making the progress of science in such areas to be awfully slow.

8. Thought Patterns in a particular Culture affect the Process and Content of Science

The thought pattern of a society will affect scientists' attitudes toward competition and cooperation and the ways in which activities of different scientists and groups are coordinated. Some scientific investigation involves a conglomeration of scientists from different regions of the world. The thought patterns of these regions would determine, whether the group of scientists would be able to work together to achieve the desired goal or not. Conflict of thought patterns could inhibit the progress of science.

The "logical and aesthetic tastes of a community affect the characteristics of written and oral presentations of scientists, such as the blending of modes (verbal, visual, mathematical), the degree of simplification, and the balance between abstractions and concrete illustrations or analogies" [14]. Thought patterns also tend to influence the production of certain types of observation-and-interpretation rather than other types. For example, thought patterns could influence a preference for either controlled experiments or field studies, and data collection that is

qualitative or quantitative. Thought patterns of a particular community therefore, determine the method and process of science in that region. This means that science in a given area bears the marks of the thought pattern of that region.

An intellectual cultural environment will favour the invention, pursuit and acceptance of certain types of theories. This shapes the design of experiments; determines what is to be studied and how it is to be studied; it spells out the types of data to be collected and the criteria to be used for theory evaluation. Thought patterns" can exert a strong influence on conceptual factors, such as preferences for the types of components used in theories, the optimal balance between simplicity and completeness, the value of unified wide-scope theories, the relative importance of plausibility and utility, and the ways in which a theory or project can be useful in promoting cognition and research" [15].

The thought patterns of a particular community not only determine the process and contents of science, it also determines the goals of science in that area. Scientists from a particular society with a particular thought pattern would tend to prefer some methods of observation and experimentation that are aligned to the thought pattern they imbibed from their cultural surrounding.

This influence of thought style on scientists has been employed by many advocates of homogeneity of scientific groups to argue against diversity of scientists in a research team. They believe that scientists need to be homogenous with regards to thought styles. Their argument is that, since diversity would result in different scientists bringing in different thought patterns; it would bring disagreement among the scientists in respect to the methods and goals of the scientific research.

9. Science also imprints on Culture

As was stated above, science too can imprint on its resident culture. Scientific discoveries, inventions and explanations for instance, play a major role in shaping cultural world-views, concepts, and thinking patterns. Sometimes this occurs by the gradual unintended diffusion of ideas from science into culture. At other times, it occurs through a conscious effort, by scientists or non-scientists, to use scientific theories and evidence to explain or support a particular belief system or political ideology.

Right from the modern period, science has had an increasingly strong influence on cultures of almost all countries in the world. The modern period is when faith in science was increased because of the successes of science through the works and discoveries of notable scientific figures like Copernicus, Kepler, Galileo, Newton, Einstein, Bohr etc. This nineteenth century scientists discovered that "the world was orderly; that the movement of the stars was predictable and that all terrestrial and celestial phenomena follow the same scientific laws like clockwork. They believed along with Galileo that the book of nature is written in the language of mathematics, with characters represented by geometric objects" [16]. The mission of science became to discover the laws of nature – with this they believed they could explain all natural phenomena. They succeeded in explaining many world phenomena with the use of experimentation and mathematics thereby making the community to develop faith in science [17]. This faith in science gave rise to the philosophical movement called positivism, which held that any knowledge claim that does not follow the method of science is not knowledge. Subjects like Metaphysics were dismissed for its failure to pass the verifiability test. At this period the influence of science became soenormous that almost all cultural belief-system was measured against science to ensure its authenticity. Anything that was not scientific was not taken seriously. At this period therefore, cultural beliefs were radically changed. Thought patterns too were changed. Perception was changed. Up till today, the Darwinian theory of evolution still influenced social phenomena like eugenics and racism. The faith in the possibilities offered by scientific progress still shapes the beliefs and actions of people today; in fact, expressions such as "this has been scientifically demonstrated," are often used to cut short a discussion.

The work of scientists implies that they challenge accepted cultural explanations of facts and propose new ways of interpreting them. The acceptance of this new explanation by science reshapes the culture of that place. The success of science, and the use of scientific knowledge, has profoundly changed everyday life, mainly in developed countries. Life expectancy has increased strikingly. Cures are available for many diseases, changing a lot of cultural beliefs about diseases. Agricultural productivity has increased to match demographic developments; and technology has freed humankind from arduous labour. New methods of communication, information handling and computation have brought unprecedented opportunities and challenges. This scientific progress has changed lifestyles all round the world; it has changed communication methods (from letter writing to emailing and faxing); it is revamping and modernising almost all other ingredients of culture. Every culture is more dynamic now than it was in the ancient period because of the influence of scientific growth.

Though it could be argued that most of the progress of science has had positive impact on culture, it is also true that science too has had a negative impact on culture. Science leads students to deny the validity and authority of the knowledge transmitted to them by their parents and grandparents and creates tension in several societies [18]. The penchant of science to put to doubt the

cultural beliefs of societies is capable of leading to social crisis, especially in societies who see the scientific views as foreign to them. Graduates of science most often especially in the developing countries, tend to disparage traditional cultures, which puts them at loggerhead with their societies. Science therefore could alienate students from their culture and thereby creating tension.

10. Evaluation and Conclusion

This paper has shown that the development of science is greatly influenced by the culture of the society. Since scientists come from a culture, what they research on, the methods they undertake and the goals they seek are all determined by the cultural values of the societies they came out from. Every science therefore, since it is developed by cultural beings and is situated in a cultural environment, must bear the imprints of culture.

However, the influence of culture on science is not one directional; science also influence culture. The Copernican revolution for instance changed the beliefs of the society from geocentricism to heliocentricism. Prior to the time of Copernicus, the society believed that the earth is the centre of the universe, with other planets revolving around. Copernicus changed this belief by theorizing that it is the earth that revolves around the sun alongside other planets and not the other way round. Other scientific discoveries like Einstein's theory of relativity also changed the beliefs of the society in classical mechanics. Science therefore also leaves an imprint on the culture.

Culture and science are therefore, twin concepts that always go together, influencing each other in turns. Culture pulls science and science in turn pulls culture but eventually the two ultimately go together. There is always an imprint of culture in every science and there is an imprint of science on every culture. In other words, taking any science emanating from a culture, one would be able to discern the marks of the resident culture on the science. That is, one in a latter age would be able to decipher, the kind of culture that gave rise to that particular science. The reverse is also true, taking any part of cultural artefacts; a good archaeologist would be able to determine the level of science in that age.

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