



Fundamentals of Scientific Thinking in Islamic Tradition

Ibrahim A. Shogar, PhD

Department of Computational and Theoretical Sciences,
Kulliyah of Science, International Islamic University Malaysia

Abstract

This article investigates fundamentals of scientific thinking in Islamic tradition to elucidate its epistemological and cultural elements. The phrase '*Scientific Thinking*' is generally used for the intellectual activity which encompasses both the content of knowledge and set of reasoning processes that permeate the field of acquiring knowledge. Formation of systematic mind, systemization of inquiry, and construction of an objective research method are the major characteristics of scientific thinking. The investigation on source, cause, and aspects of systemization of inquiry is, therefore, contributes immensely in development of scientific enterprise. The major approaches in the history of science that contributed in systemization of inquiry are such as the rational approach that espoused by the ancient Greek philosophy, formation of scientific mind that introduced by the Qur'anic revelation to investigate the natural phenomena, and the experimental method of modern science that based on systematic observation. This article aims to investigate the case of Qur'anic approach to investigate nature and its contribution in developing matrix of scientific thinking in Islamic tradition. The Qur'anic exposure of human thought to the natural phenomena based on systematic observation had contributed and played a major role in development of science in early history of Islamic civilization, preservation of scientific legacy of ancient civilizations, and subsequently have caused the emergence of modern science. The major characteristics and the peculiar features of scientific thinking in Islamic tradition will be investigated. The epistemological and cultural aspects of scientific thinking in Islamic tradition will be investigated as well.

Keyword: *Scientific thinking, epistemological aspects, social dynamisms, Islamic tradition, rational framework, systematic inquiry*

Abstrak

Kajian ini menganalisa asas pemikiran saintifik dalam tradisi Islam untuk memahami elemen epistemologi dan budayanya. Frasa 'Pemikiran saintifik' secara amnya digunakan untuk aktiviti intelektual yang merangkumi kedua-dua pengisian pengetahuan dan set proses penalaran yang merangkumi bidang untuk memperoleh ilmu pengetahuan. Pembentukan minda sistematik, sistem pertanyaan, dan pembinaan kaedah penyelidikan objektif adalah ciri utama kepada pemikiran saintifik. Penganalisisan terhadap sumber, punca, dan aspek sistemisasi penyelidikan, merupakan penyumbang dalam pengembangan pembangunan ilmiah. Pendekatan utama dalam sejarah sains yang menyumbang dalam sistem penyelidikan adalah seperti pendekatan rasional yang diguna pakai oleh falsafah Yunani kuno, pembentukan fikiran saintifik yang diperkenalkan oleh wahyu Al-Qur'an untuk menyelidik fenomena semula jadi, dan kaedah percubaan sains moden yang berdasarkan pemerhatian sistematik. Artikel ini bertujuan untuk mengkaji kes pendekatan Qur'anic terhadap alam dan sumbangannya dalam membangun matriks pemikiran saintifik dalam tradisi Islam. Pendekatan pemikiran umat manusia terhadap fenomena alam berdasarkan pemerhatian sistematik telah menyumbang dan memainkan peranan penting dalam pembangunan sains dalam sejarah awal tamadun Islam, pemeliharaan warisan saintifik tamadun purba, dan seterusnya telah menyebabkan kemunculan moden sains. Ciri-ciri utama dan ciri-ciri pelik saintifik dalam tradisi Islam akan dikaji. Begitu juga kajian berkaitan dengan aspek-aspek epistemologi dan budaya pemikiran saintifik dalam tradisi Islam.

**Corresponding author:*

Ibrahim A. Shogar,
Department of Computational and Theoretical
Sciences, Kulliyah of Science, International
Islamic University Malaysia
Email: shogar@iium.edu.my

Kata kunci: *Pemikiran saintifik, aspek epistemologi, dinamisme sosial, tradisi Islam, kerangka rasional, pertanyaan sistematik.*

1.0 Introduction

The reflective and analytic investigation on scientific thinking in Islamic tradition is increasingly becoming necessary to the contemporary Muslim intellectuals for many reasons. *Firstly*, to understand the epistemological and cultural aspects of scientific thinking that characterized the early history of Islamic scholarship; *secondly*, rediscovery of mechanisms of research spirit that motivated the early Muslim intellectuals to engage tirelessly in investigation of the natural and human phenomena; *thirdly* to recognize the peculiar characteristics and the rational framework of inquiry upon which the vital research spirit was developed and scientific activities were undertaken; and *lastly*, to investigate how the rich legacy of scientific thinking in Islamic tradition can contribute in addressing the major problems of modern secular philosophy of science which dominating the world today.

Despite the growing set of works on Islam and science, by Muslim and non-Muslim intellectuals, that have been investigating the topic over the last few decades, however only few authors have addressed analytically the major issues of Islamic epistemology, such as the question of research methodology, the rational framework of explanation, and the cultural aspects of scientific inquiry. This may indicate that a comprehensive and analytic exploration on fundamentals of scientific thinking in Islamic tradition is yet to be conducted. Among the few exceptions to the above observation should include the successful attempts of Alparslan in adopting the analytic approach on this topic. Publishing a considerable set of works on Islamic thought throughout the last few decades, Alparslan has been committed to the analytic method of inquiry, especially in his work published in 2014 by Institut Kefahaman Islam Malaysia, entitled “*Islamic Scientific Tradition in History*” (Acikgenc, 2014). The method espoused by the author in this work resamples that of Thomas S. Kuhn in his renowned work “*The Structure of Scientific Revolutions*”. The major difference between the two works, however is found, not in their subject matter, nor in their method of analysis, but rather in their objectives and final goals. The focus point of the former author was to investigate the historical development of scientific thinking in Islamic tradition to revive the Islamic thought, while the later was focusing on history of modern sciences.

The basic advantage of the analytic approach to scientific thinking is that it determines the future directions of scientific progress based on analysis of fundamentals, the fact that may lead to creation of research spirit and revival of the scientific legacy. Building the scientific mind is important in the modern Muslim community for many reasons, especially to

overcome challenges of development that posted by the globalizing world. This article aims to investigate fundamentals of scientific thinking in Islamic tradition. This includes the rational framework of explanation, the question of methodology, and social and epistemological aspects of scientific thinking in Islamic tradition. Understanding matrix of scientific thinking in Islamic tradition is important to rediscover its mechanisms and the motivational force of research spirit that characterized the early history of Islamic scholarship. It is also important to rebuild the indispensable connection between knowledge and virtue that articulated by the holy Qur'an. Nevertheless, the Islamic framework of study can be introduced as an alternative perspective to the epistemology of modern science which assumes the value-free knowledge. The reference to the holy Qur'an is, especially, important to rebuild the relationship of Islam and science and its rational framework of explanation. The central question that will be explored is how Islamic tradition had affected the course of scientific thinking, and how it can contribute again to rebuild the scientific spirit in modern Muslim communities? This article aims to investigate this question and elucidate its conceptual and rational framework.

2.0 Genesis of Scientific Thinking

The history of science is regarded as a process of progressive accumulation of techniques and the refinement of quantitative methods in the study of Nature. (Nasr, 1984). The origins of scientific thought, thus, to be sought in the records of early man as given by geologists who study the structure and history of the earth, and by anthropologists who observe the physical and social characters of mankind. (Dampier, 1948). Aiming at understanding sources of its dynamic changes and systematic processes, mankind over the course of history has been concerned with investigation of the natural world for many reasons. Science, philosophy and religion have been the major approaches for quest of truth across the human history. Before 15 century, there was no clear distinction between philosophy, theology, and science. The three methods of truth inquiry were also integrated during the dominating periods of Islamic civilization. However, by seventeenth century both philosophy and science were separated from theology in the Western world. Religion was separated from the two other components of human knowledge by the name of ‘objective method of inquiry’, i.e. knowledge that measurable by empirical means. This has led to secularization of scientific enterprise.

2.1 Scientific Thinking

The phrase ‘*Scientific Thinking*’ is generally used for the intellectual activity, which refers to both thinking about the content of knowledge and the set of reasoning processes that permeate the field of knowledge inquiry, such as systematic observation, inductive and deductive reasoning, causal explanation, concept formation, experimental design, and hypothesis testing (Zimmerman, 2007; Dunbar & Fugelsang, 2005). The scientific thinking can be conceptualized in two interconnected contexts: *firstly*, in the context of epistemological philosophy; and *secondly*, in the context of cognitive developmental science. Scientific thinking in epistemological context is the major concern of philosophers of science, and it can be defined as application of methods and principles of the objective inquiry to investigate a phenomenon or to solve a problem. It mainly used for the systematic method of inquiry that is guided by principles of observation and reasoning. This includes a set of concepts, principles and ideas emerged and clustered in a specific epistemological and cultural environment. The focus point of scientific thinking in this philosophical context is to contribute in generating ideas, formation and modification of scientific concepts, and development of theories about the natural and social world. This is the meaning which aimed by this article.

According to cognitive and developmental research perspective, scientific thinking can be defined as a mental process which involves various skills, such as observation, experimentation, and reasoning to generate new knowledge. Developmental psychologists have been interested in scientific thinking because it is a fruitful field for studying conceptual formation and change, the development of reasoning and problem solving, and the trajectory of the skills required to coordinate a complex set of cognitive abilities. Educators and educational psychologists, on the other hand, have shared this interest, but with the additional goal of determining the best methods for improving learning and instruction in science education. Research by developmental and educational researchers, therefore, should be mutually informative (Zimmerman, 2007).

The scientific thinking meant by this article is conceptualized in the epistemological context, which provides mechanisms and principles for systematic inquiry to understand the complex systems of the natural processes found in physical and biological phenomena. The scientific thinking, in this context is a collection of ideas and methods which can be influenced by other social and cultural settings of knowledge. Increasing attention is now being paid to how these concepts can help researchers and

practitioners to understand and influence social, economic and political phenomena (Ramalingam, Jones, Reba, & Young, 2008).

The scientific thinking in the context of Islâmic tradition can be understood in the framework of both: (i) the insights and guidelines provided by the holy Qur’an for proper method of inquiry and discovery of the truth; and (ii) contributions of early Islamic scholarship to develop the scientific method for proper understanding of the world. Of course, the scientific method today is highly developed, ranging between mechanical processes of physical sciences to complex systems of biological sciences. Discovery of the Qur’anic insights on this matter should motivate Muslim intellectuals to revive the research spirit and contribute in scientific and social development.

The scientific thinking in Islamic tradition is characterised by the following features:

- Motivated and guided by principles of revealed knowledge that integrated with moral values;
- Thinking methods are directly related to the principle objectives of Islamic law (*Shari’ah*);
- It gives a significant implication towards investigation and understanding of natural phenomena and development of human community;
- Revelation as a dynamic source of knowledge and motivational force of inquiry;
- Quest of knowledge and discovery of the truth are aimed for religious purposes.
- Knowledge inquiry should be based on objective methods, which are measurable either by logical reasoning or empirical testing; Science and technology are means rather than being final goal.

2.2 The Historical Background of Scientific Thinking

Scientific thinking is considered one of the hallmarks of the human species, along with art, music, and literature. Illuminating the thought processes used in science therefore reveals key aspects of the human mind. The thought processes underlying scientific thinking have fascinated both scientists and non-scientists because the products of science have transformed our world. (Dunbar & Fugelsang, 2005). The adjective ‘scientific’, according to some authors, can be used for the intellectual activities prior to the emergence of sciences, as a ‘*scientific consciousness*’ that is required by the systematic nature of our mind. (Acikgenc, 2014). Therefore, foundations of systematic inquiry can be found even in the ancient history of science. Magic, astrology and conventional religions can be studied with the origins of science,

though their exact historical relations with science and with each other are still uncertain. Some order in empirical knowledge appears in the records of ancient Egypt and Babylon units and rules of measurement, simple arithmetic, a calendar of the year, the recognition of the periodicity of astronomic events, even of eclipses. But the first to submit such knowledge to rational examination, to try to trace causal relations among its parts to create science, were the Greek natural philosophers of Ionia. (Dampier, 1948).

What is known as 'science' has arose in Western world as a result of a new spirit of inquiry, of new method of investigation, of the method of experiment, observation, measurement, and of the development of mathematics in the sense that unknown to ancient and medieval thought. The spirit of systematic inquiry that is based on methods of observation and experiment was introduced to the Western world by Muslim works where have led to Scientific Revolution. The primary source of research spirit and those methods was the Qur'anic revelation which is decidedly considered as the most dependable source of knowledge which reveals its truth through nature, history, and human society. (Siddiqi, 1984; Mirza & Sddiqi, 1986).

The holy Qur'an emphasizes the systematic inquiry and investigation of the world for both temporal and religious purposes. The scientific thinking in Islamic tradition is, therefore, inspired by the Divine revelation. It is a mode of intellectual engagement with nature that triggered by the principles of the Islamic worldview for quest of truth and guided by the common ground of scientific thought in Islamic tradition. The proper understanding of the Divine revelation and conscious application of the principles provided by the revealed knowledge is, therefore, essential to maintain the spirit of scientific thinking. The terminal goal of systematic inquiry in Islamic tradition is at harnessing potentials of the material world for meaningful life that appreciates the Maker of the world. In other words, it aims to harness the temporal for the Absolute. Scientific investigation is, accordingly, regarded as an important form of religious practices (*Ibadah*) and a considerable method toward recognition and appreciation of the Creator. Systemization of inquiry is, therefore, the most characteristic feature of scientific thinking in Islamic tradition.

2.3 The Question of Systematic Inquiry

The basic aim of scientific research method is to generate new knowledge through understanding the major aspects of natural process and role of science in society development (McLeod, 2011). As much as mankind needs to know the world, i.e. to explain and

understand its nature, events and dynamic processes, he also concern more importantly with the suitable and proper method of inquiry that guides the way to the true knowledge which verifiable by authentic means. Across the history mankind have attempted various approaches to understand and obtain the true knowledge of the world, including philosophical, religious and scientific approaches. However, the great efforts of mankind that have been offered for discovery of the truth of the world were unsuccessful in many cases due to what is named by (Kuhn, 1996) as '*incommensurable ways of seeing the world*'. These are the arbitrary methods of interpreting the world which have no common standard for measuring or judgment.

Observation and experience can be drastically restricted to provide a reliable knowledge and justified belief; otherwise there would be no science. The arbitrary element, that is compounded of personal, cultural, and historical accidents are always create a formative ingredient of the unjustified beliefs espoused by a given scientific community at a given time. These elements of arbitrariness do not, however, indicate that any scientific group could practice it without some set of received beliefs, nor does it make less consequential the particular constellation to which the group, at a given time, is in fact committed. (Kuhn, 1996). An effective research spirit, according to Kuhn, begins when a scientific community which adopts it acquires firm answers to the fundamental questions of human thought, such question on source of the primary elements of matter, purpose of life, and final destination of the universe. The scientific method is primarily analytic, aiming at explanation of the phenomena in a mathematical form and in terms of physical concepts. But the fundamental concepts of physical science, as now understood, are abstractions, framed by our minds so as to bring order and simplicity into an apparent chaos of various phenomena and different events. The approach of reality through science, therefore, gives only aspects of reality and pictures drawn on simplified lines, but not reality itself. Nevertheless, even philosophers are coming to see that, in a metaphysical study of reality, the methods and results of science are the best available evidence. (Dampier, 1948).

From Islamic perspective, science is not a divine revelation but it provides means for betterment of mankind and for better understanding of God's creation and its purpose. Science is method to acquire the true knowledge and Islam has put great emphasis on acquisition of knowledge. The holy Qur'an urges mankind to study and examine the natural and human phenomena. In fact, the more one investigate the more one knows about the Creator of the world and His

scheme of the universe. Obviously the emphasis on thinking leads the way to the cherishing care of God who has created all things in nature to function for the benefit of mankind. The human genius and faculties of intellect are the means which has given by God for this purpose (Mirza & Sddiqi, 1986).

3.0 Fundamentals of Scientific Thinking

The history of science has been viewed under two aspects: either positively as the gradual unfolding of truth, the increase of light; or negatively as the progressively triumph over error and superstition, the decrease of darkness. Every peculiar tradition of scientific thinking is based mainly upon three fundamental components: (i) the rational framework of explanation (ii) the conceptual framework, and (iii) the epistemological and social context.

3.1 Rational Framework of Explanation in Islamic Tradition

The rational framework of scientific thinking constitutes the philosophical and the metaphysical foundations of scientific explanation. It is the major source of scientific thinking in every society. If the rational framework is powerful enough it will lead to the systemization of inquiry and progress of scientific enterprise. The Islamic worldview on man, nature and the Absolute Being is the relevant example. The arts and sciences in Islam are based on the idea of unity of God, unity of nature and unity of mankind. This is the core of the Islamic worldview and the heart of the Qur'anic revelation. Just as all genuine Islamic art, everywhere, provides the plastic forms through which one can contemplate the Divine Unity manifesting itself in multiplicity, so do all the sciences that called 'Islamic Science' reveal the unity of nature, which displays unity of the Creator. By showing the unity and interrelatedness of all that exists and contemplating the unity of the cosmos, man may be led to the unity of the absolute Divine Truth. (Nasr, 1984).

For a meaningful life and proper development of human community, man needs two modes of knowledge: (i) knowledge of the natural world that is necessary to understand the systematic orders of nature to fulfil his material needs; and (ii) knowledge of principles of the right conduct and right behaviour (values), at both individual and collective levels, which enables man to manage himself and his community to maintain justice, peace, harmony, and tranquillity for all (Ahmad, 1980). We can use the terms '*descriptive knowledge*' and '*normative knowledge*' for the above two modes of human knowledge. Although, the Divine revelation has played an important role to guide human community to the normative knowledge, but the

descriptive type has remained unsuccessful in many cases due to the lack of scientific thinking. The approaches adopted to achieve this important goal were unsuccessful in many cases due to the domination of mythology and superstitious beliefs. The holy Qur'an rejected such superstitious beliefs, and shifted man's attention to the study of the systematic orders of natural phenomena based on rational approach. Instead of myth, the holy Qur'an adopted the thinking and reasoning as reliable methods to uncover the systematic orders and natural systems that emphasize the existence of their Originator.

In fact, the holy Qur'an, emphasizes both the normative and descriptive modes of knowledge, but Muslim communities usually focus on the normative knowledge, believing that it could lead to the right action. The systematic study of nature has been removed from curriculums of education and learning after middle ages. Even mathematics, which featured by Islamic elements, due to the inspiring mathematical data that provided by the holy Qur'an, and also due the unprecedented contributions of early Muslim mathematicians, has been neglected in later history of Islamic civilization. This was totally against the Qur'anic strategy and approach to the natural phenomena that based on scientific thinking, as a basic gateway to knowledge of God. The holy Qur'an contains more than eight hundred verses that talk about the natural phenomena.

3.1.1 Tawhid as Framework of Explanation

The genesis of scientific thinking is generally based on three elements: (i) the worldview or the rational framework of explanation that provides the metaphysical foundations of inquiry; (ii) epistemic (cognitive) aspects, that is the rational process of observation, description, classification, and explanation, which is a common feature to all mankind; and (iii) the cultural or conventional aspects include the motivational force, methodological and technical approaches that could be attached to certain culture or specific community. This later element constitutes the social aspect of scientific thinking that could be influenced by social settings and cultural changes; and it also determines the nature of scientific thinking of certain community.

Thinking and the systematic understanding of the world must be established on specific framework of explanation, known as 'worldview'. It is the philosophical framework based on which human interprets the entire being, including the physical and metaphysical worlds. In other words, worldview is the way, a theoretical method, that man answers the ultimate questions of human thought about the universe, life and the final destination of mankind. The

rational and critical approaches that adapted by the early natural philosophers has exposed human thought to some basic principles of the right framework of investigation in the natural phenomena. For instance, they believed that what is real must be rational, and what is rational must be real. This view was fully developed later by Aristotle as framework of explanation in his Causation Theory, which based on four types of causes: (i) material cause, (ii) formal cause, (iii) efficient cause, and (iv) final cause. This theory has proved that existence of the Creator (the efficient cause) is necessary for rational explanation / understanding of the world. There must be an eternal Power who initiates things or let them *move* for first time and entre in the circling motion of life. For example, He creates a seed first then the seed will produce a tree which will reproduces a seed again, so that the motion of life will get started in certain species of living things and continue. Therefore, the Creator of the universe in this case is named according to Aristotle as the “Efficient Cause” or the “First Mover”. But the major problem of the causation theory, with regard to this point, is that it presupposes that the Creator dose not interfere any more in the affair of the world after creation, or after the first move! In other words, nature will function by its own internal laws which determined by the Creator, or even by nature itself as claimed later. This view, according to Islamic view, is to say: God is a Creator but not a Sustainer of the world!

In fact, the causation framework of explanation, which removes role of God from the natural processes, is the metaphysical foundation or the philosophical background of modern secularization of human knowledge. The rational evidences are more supportive to the fact that who has power to originate things will not leave them alone, but care them to achieve their purpose of creation. Therefore, the holy Qur’an totally rejected the above hypothesis of “First Mover” and instead has exposed human mind to *Tawhidic* framework of explanation, where the God is regarded as Creator and as well as Sustainer of the world. There are two major questions have been posted by classical Islamic theology, with regard to some parts of *Tawhidic* framework of explanation. The first question was about how we ethically understand free will or freedom of act if God interferes to determine our deeds? And the second question holds that if God interferes at any moment to change the natural laws then how we will be able to understand the world? Both questions were discussed by early Muslim theologians, especially between al-Ghazali and Ibn Rush, but, the major source of confusion in fact was due to negligence of the Qur’anic concept of *Sunnatullah* (the established method of God to deal with His created world), which

repeatedly asserted by the Qur’anic verses more than ten times.

The *Tawhidic* framework of explanation is embodied in the Islamic worldview, but the worldview must be developed, cared, and maintained by scientific thinking, because it can be affected by the cultural and social settings of human community. In fact, this is the major problem of the Muslim communities today, because in the absence of systematic thinking, the Islamic worldview has lost its dynamic spirit and turned into mere beliefs which have no real implications on practical life of Muslim individuals. Muslims are individually performing their religious duties, such as prayers and fasting, perfectly, but all these daily practices could not guide their everyday behaviours and acts. With the absence of the effective worldview, the collective duties of Islam which are more essential for community life and social development, such as unity, social justice, peace, and brotherhood, were turned to be inactive. Many Muslim intellectuals have emphasized on this problem, but there was no real mechanism to reactivate the genuine power of the Islamic worldview except by revival of scientific mind which motivates to engage in systematic inquiry. Systematic inquiry. Discussing the cultural impacts on scientific thinking, Mario Bunge observes that “the cultural poverty of contemporary Islam, with its nearly total absence of original science, technology, and art, is in stark contrast to the brilliance of its culture in the Middle Ages. This fact is an aspect of a multifaceted stationary process. While the Islamic societies, particularly those rich in the Devil’s juice, have imported some of the trappings of modern industry, such as cars and cell phones, most of them have kept a traditional social structure. Indeed, they have discouraged or even banned the quest for novelty, economic, political, and cultural, which is precisely the quest that built modern capitalism and keeps it going.”

3.2 The Conceptual Framework

The Islamic epistemology has developed its own conceptual framework for scientific thinking and explanation. Many of such scientific concepts are provided by the holy Qur’an, which invites human intellect to think, investigate and examine the natural world for religious purposes. There are enormous scientific concepts in the holy Qur’an that need to be investigated separately, but good examples are such as *‘ilm* (علم), *ma`rifah* (معرفة), and *yaqeen* (يقين), which stand for a reliable knowledge. There are other concepts for non-reliable knowledge, such as *zann* (ظن), *shakk* (شك), and *raib* (ريب).

The conceptual study of scientific thinking plays a major role to understand its foundations for revival of scientific legacy. For instance, the concept of *‘ilm* has

been playing a central role in development and promotion of scientific inquiry across the history of the Islamic civilization. The eminent orientalist of Islamic thought, Franz Rosenthal observes that Civilizations tend to revolve around meaningful concepts of an abstract nature which, more than anything else, give them their distinctive character. Such concepts are to be found at the very beginning of a rising civilization. Or they may signalize, when they first make their appearance, an entirely new departure toward the eventual transformation of the environment hospitable to them. In the course of time, they may undergo changes of tone and volume. Such changes may be minor and merely serve to strengthen the hold exercised by the concepts before. But they also may provide the old concepts with new meanings. This signifies a fundamental change or a major break in the structure of the civilization in which it happens. The concept as such may continue to be used, thereby obscuring the meaning and depth of the change or even totally hiding the very fact of its existence. If, on the other hand, they cease to be used in any meaningful manner, it is a clear indication that the civilization which lived by them is no longer fully alive (Rosenthal, 2007).

3.3 The Epistemological and Cultural Context

Science as a human activity is based on two grounds: epistemological and sociological aspects. The epistemological ground of science, according to Acikgenc (2014), can be deduced primarily from its cognitive nature. The scientific tradition, on the other hand, is a social phenomenon, which springs from the social constitution of our nature and as such cannot be deduced from the cognitive aspect of science. This leads us to distinguish the cognitive, or rather the epistemic ground of science from its social aspect. In fact, these two aspects of science spring from two aspects of man, which must be somehow reflected in all human activities as well; epistemological and sociological.

3.3.1 The Social and Cultural Foundations of Scientific Thinking

There are cultural elements that grow out of the worldview of the civilization, and these elements affect the course in which the scientific process takes place in history. Moreover, there are also other historical factors that may affect the specific direction of scientific process. One example for this in Islamic scientific tradition was the availability of Greek sources and means to acquire them when Islamic scientific process was in its developmental stage. Elements of Greek thought had affected, positively or

negatively, the course of the scientific process in Islamic civilization (Acikgenc, 2014).

Development of scientific tradition, according to Alparslan, 2014, depends firmly upon what he named as “*morally sensitive group in quest of knowledge*”. These morally sensitive people constitute the foundation and dynamism of scientific tradition in society because of their worldview and they are interested in knowledge inquiry not for other purposes but from an ideal perspective that based on moral obligation and for religious motives. They seek knowledge not for a worldly purpose or out of idle curiosity; they acquired knowledge for virtue of and in order to gain God’s satisfaction. As a result, these knowledge masters attach the same moral significance to knowledge they are able to mentally extract from their worldview. In this way, a huge knowledge activity will be initiated in the society as exemplified by early history of Islamic civilization (Acikgenc, 2014).

Revelation of the holy Qur’an, as rightfully observed by many authors, has created two revolutions (i) social revolution, and (ii) intellectual revolution. Muzzafar Iqbal (2007), notes that the social revolution was reflected by the rapid integration of numerous cultures into the fold of Islam. The geographical expansion of Islam within its first century was accompanied by a social revolution that reconfigured the social, cultural, and intellectual climate of the old world. The same social revolution provided an opportunity for Islamic civilization to receive a very large amount of scientific material from Greek, Persian, and Indian sources. This infusion was not a random process; rather, it was an organized and sustained effort spread over three centuries, involving thousands of scientists, scholars, translators, patrons, books, instruments, and rare manuscripts. Iqbal farther explains the impact of social revolution on scientific revolution, saying: as we proceed with the account of the emergence of science in Islamic civilization, we note that the Islamic scientific tradition was emerging in a cosmopolitan intellectual milieu and that those who were making this tradition were not only Muslims but also Jews, Christians, Hindus, Zoroastrians, and members of other faith communities. The emergence of the scientific tradition in this multi-religious, multi-ethnic atmosphere was a dynamic process involving interactions between patrons of learning, scholars, scientists, rulers, guilds, and wealthy merchants. (Iqbal, 2007)

3.3.2 The Common Grounds of Islamic Scholarship

One of the basic social aspects of scientific thinking is formation of common ground of scholarship for specific society or culture. Historians of science, therefore, have noted various platforms and common

grounds that had led the Islamic scholarship to the success. Beside unity of the worldview, epistemology, and source of knowledge, Muslim scientists also share other significant elements of knowledge inquiry, such as unity of scientific concepts and terminologies which offered by the holy Qur'an which revealed in Arabic (unity of language); and unity of moral values which constitutes their research ethics that is provided by Islamic Shari'ah. Muslim scientists and scholars of today might not be aware of the crucial role that these factors can play in scientific progress, but it was obviously noted by some historians of science. They especially pointed out the following aspects of common grounds in Islamic scholarship:

1. The common worldview: The Islamic worldview, providing the rational framework of scientific explanation through unity of God, has equipped the Islamic scholarship with unity of source of knowledge, unity of philosophy of science and the epistemological framework, and unity of the final objectives of knowledge inquiry. These aspects have provided a firm base for scientific thinking in Islamic tradition upon which Islamic civilization was build. Due to the emphasis of Islamic worldview on pursuit of knowledge, the Muslim scholars gained access to the scientific legacy of other civilizations, such as Greek and Roman texts from the Byzantine along with Indian sources of learning.

2. Unity of scientific concepts and terminologies: Using a single scientific language which was Arabic, allowed Muslim intellectuals, who were from various ethical backgrounds, different culture and ethnicities; to communicate among themselves and access to scientific legacy of each other without need for translators. This has led to the unity of scientific terms in the scientific enterprise. Based on this advantage, Muslim scholars and scientists were able to communicate with the holy Qur'an which was revealed in Arabic to obtain principles of scientific knowledge, concepts and terminologies, and guidance for virtues and meaningful life.

3. Unity of the grand annual conference (al- Hajj). If today we are able to organize international conferences with few efforts, it was very hard – if not impossible- to organize such conference which brings all scholars together across the global community for any purpose. However, organizing such a global conference was possible for Muslim scholars due to the annual pilgrimage to *Makkah*. It considered as an annual conference which facilitates scholarly collaboration by bringing together Muslim scholars from various parts of the world to exchange

ideas, knowledge and new information for scientific progress. In fact, the holy Qur'an have shifted attention of pilgrims to other benefits of this annual event other than the religious objectives.

4. The common moral code: Observation of research ethics is a crucial factor of scientific progress. On the other hand, the rapid progress and development of science and technology produces new ethical challenges. Therefore, ethics and science in Islamic tradition are integrated to work for human progress. John L. Perkins (2003), notes that success of scientific thinking in Islamic civilization was due to its provision of a common moral code which provided a great advance over tribal culture, assisting commercial relations, trade and trust between traders.

Due to all the above factors, and based on the inspiration from the holy Qur'an and Sunnah of the Prophets (S.A.S), Muslim intellectuals developed moral code of scientific research and sense of respect to authority of knowledge disciplines, and tolerance to other views. Based on knowledge aspect, Muslim intellectuals became references to true knowledge across the world. Thus, for more than five centuries, the Islamic civilization remained the basic source of science, technology and prosperity.

3.3.3 The Epistemological Foundations of Scientific Thinking

The scientific thinking, as process of learning, is natural and common feature to all mankind. It is the mental (cognitive) process that includes observation, description, classification, and explanation, which shared by both young and adults. Accordingly, educators believe that the development of scientific thinking occurs across human life. Young intuitive scientists, layman, and mature professionals, all exercise the scientific thinking, use evidences and make conclusions. The only difference between them, according to Kuhn & Pearsall (2000), is that in the case of mature professionals, the coordination of theory and evidence is carried out under a high degree of conscious control.

The basic question now is about what theory is and what is evidence in the process of scientific thinking? The simple answer to this important question is that in the process of pursuing knowledge of the external world, mankind observes many things, experiences events and cases; then he tries to understand these things and interpret the events based on observation, description, classification, and so on, before s/he makes conclusions (generalization). We explain the process of scientific thinking by the following

example: a mother brought a small plant to her child to learn how to care things. Every day the child puts some water to the plant then he observes that the plant is growing. But one day he wants to give more care to the plant therefore he covered it by big plate. After few days the child opened the plate and he noticed that the green leaves of the plant have become yellow!

To explain the process of learning (scientific thinking) in the above case, we say: *the first* question that the child will arise when he received the plant would be ‘*what is this?*’ then the mother will answer: it is a “plant”, thus, the child knows meaning of plant (naming), while matching between the word and the thing. His knowledge in this case is known as “categorical knowledge”, because human learns things by categorization and naming. This would be the first and the basic mode of human knowledge, thus, the holy Qur’an says:

“Allah taught Adam all the names” (The Qur’an 2:30).

The second type of knowledge would be about the basic features of the plant, for instance child’s observation of the relationship between water and growth of the plant. This mode of knowledge is known as “causal learning”, which based on the observation of consistent relationship between two events (water & growth of plant). *The third* question is about the colour of the plant that turned to yellow. In this case there are two events need to be explained: first, covering of the plant and changing its colour to yellow, which is a simple causal relationship that could be observed by the child; second, the question about why covering of the plant have changed its leaves into yellow? The child, even an adult mother, might not be able to understand this event, because it is a result of a complicated process of various systems known as (photosynthesis), therefore, it called “systems knowledge”. See table (3/3/1).

Table No. (3/3/1): An example of cognitive process of scientific thinking (epistemic) (Kuhn & Pearsall, 2000)

Level of knowledge	Type of knowledge	Example	Supporting evidences	Counter evidences
L1.	This is a plant (object) (categorical knowledge)	Plants are living things (claim)	-Plants are living things because they have characteristics of living things, such as growth. -They can grow with water	Lacking some characteristics of living things (plants cannot move).
L2.	Events explanation Causal explanatory 1 (causal knowledge)	This plant is growing	Plant is growing because of water. (all plants need water to grow)	Plans can die even with water due to some other reasons.
L3.	Events explanation Causal explanatory 2	This plant is dying	Plan is dying because of inadequate water (all plants need water to remain alive)	Some plants can survive long time even without water
L4.	Event explanation 3 complicated cases (System explanatory claim)	The green leaves of plant have turned yellow	The green leaves of the plant are turned to yellow because of the covering (plants need multivariable process of photosynthesis to maintain green) (Plants not exposed to sunlight for photosynthesis will not remain alive)	Some plans has yellow leaves even with sunlight Some plans die even with exposure to sunlight

The term ‘Theory’ is used in different contexts, but in this case it used for the initial observation of the relationship between two events (cause & effect), without understanding the relationship; or mere belief that something is true or false (claim of knowledge) without evidences. To test the truth of such claim, not only we need to provide the supportive evidences, but also the counter evidence which may prove the theory is false. When we accept knowledge claimed by others

or take our own prejudices as fact and for granted without testing, this would produce a false knowledge which leads to the development a superficial worldview. Stagnation of mind could happen due to the superficial worldview, because in the absence of the rational and critical thinking, all the mental representations are confined to a single reality defined by what the individual persons believe to be true. This is what named in Islamic tradition as (*taqlid*) or mere

imitation, without any critical evaluation of falsifiable claims. This is the central issue of scientific thinking (Kuhn & Pearsall, 2000).

4.0 Conclusion

The situation of Muslim world today, with regard to science, technology and development, necessitates investigation on scientific thinking with reference to the holy Qur'an to benefit ideas and insights. As emphasized by many Muslim intellectuals, there is an ever growing need for the study of both the principles and manifestations of Islam from its own authentic sources and in a manner that comprehensible to contemporary man. Islam, in fact, is regarded as a religion, civilization, science, and social order based upon the Divine revelation (Nasr, 2010).

In this context, we may highlight two points: first, the necessity of promoting the systemic mind; and the other is how we can benefit from the existing literature to achieve this noble goal. The first point emphasizes the effective role that played by the systemic mind to satisfy the essential requirement of society development such as research, technology and innovation; while the second point indicates the technical means and mechanisms to promote such systemic mind.

The modern Muslims communities are generally need science, technology, and innovation in comparison to other nations. Many factors can be identified as causes of this situation; but the major cause, in my view, is lack of systemic mind which characterized by abstraction, generalization and logical classification of knowledge. This assumption can be supported easily, among others, by lack of textbooks that produced by Muslim authors in all basic branches of natural sciences: physics, biology, and chemistry. This is regardless of the practical science, such as engineering and communication technology. The Qur'an injunctions on the natural and human phenomena, and existence of systemic thinkers in Islamic history, such as Ibn al-Haytham, Ibn Sina, al-Asfahani, al-Ghazali, and Ibn Khaldun, eliminate the claim that the problem is connected to Islam; rather it relates to some inherited cultural traditions that hinders the systemic thinking.

4.1. The Necessity for Systemic Mind

To overcome this major problem, the Islamic education must focus on promoting the systemic mind which adopts the interdisciplinary approach. Teachers and lecturers must be qualified to focus on basics and extraction of general principles. They may feel essential or inclined to provide the detailed knowledge of their perspective fields to the students, but more

important is the search for basic concepts and underlying principles that may be valid throughout the entire body of knowledge (Bertalanffy 1968). Promoting the systemic mind in modern Muslim societies is necessary for two basic reasons: *firstly*, it is necessary because of the current situation of science and technology; and *secondly*, the systemic investigation has become the major trend of the modern scientific research. Although the modern sciences are fragmented into detailed branches, but all scientists are aware of the fact that problems of our time cannot be solved without a holistic vision and multidisciplinary approach. John Dewey emphasizes this point as following:

“Command of scientific methods and systematized subject-matter liberates individuals; it enables them to see new problems, devise new procedures, and, in general, makes for diversification rather than for set uniformity. But at the same time these diversifications have a cumulative effect in an advance shared by all workers in the field” (Dewey 1929, p 12-13).

Dewey, further elucidates the process of forming the systemic mind as following:

“Each investigation and conclusion is special, but the tendency of an increasing number and variety of specialized results is to create new points of view and a wider field of observation. Various special findings have a cumulative effect; they re-enforce and extend one another, and in time lead to the detection of principles that bind together a number of facts that are diverse and even isolated in their *prima facie* occurrence. These connecting principles which link different phenomena together we call laws. Facts which are so interrelated form a system, a science”.

Discovery of general principles and universal laws would equip the systematic mind with substantial capabilities of knowledge inquiry, as explained by Dewey:

“The practitioner who knows the system and its laws (a system thinker) is evidently in possession of a powerful instrument for observing and interpreting what goes on before him. This Intellectual tool affects his attitudes and modes of response in what he does. Because the range of understanding is deepened and widened he can take into account remote consequences which were originally hidden from view (hidden variables) and hence were ignored in his actions. Greater

continuity is introduced; he does not isolate situations and deal with them in separation as he was compelled to do when ignorant of connecting principles. At the same time, his practical dealings become more flexible. Seeing more relations he sees more possibilities, more opportunities. He is emancipated from the need of following tradition and special precedents. His ability to judge being enriched, he has a wider range of alternatives to select from in dealing with individual situations” (Dewey 1929, pp 20-21).

4.2 The Method of Benefiting from the Existing Literature

For better utilization of existing literature for formation of systemic mind in Muslim societies, we may need to divide the available works on the topic into classical and modern. The classical literature, in this sense, indicates the substantial works of early Muslim scholars, who were known by their systemic approaches, and made their thought to develop general principles in their perspective disciplines, such as al-Shafie’, al-Asfahani, al-Ghazali, al-Shtibi, Ibn Jama`, and Ibn Khaldun. The classical literature, however, can be extended to the useful thoughts and ideas of medieval Muslim philosophers as well as ancient Greek philosophers.

In relation to the modern literatures, there are substantial works produced by many of renowned philosophers of modern science to address the topic of ‘systemization’ and systems theory, especially from the opening of the twentieth’s century. Some of these references have been indicated in the present article. There are detailed descriptions on systems theory, systemization and other related topics on the issue. For better utilization of such huge data, we should study these works farther based on principles of Islamic worldview. Therefore, rediscovery of systematic mind in Islamic tradition is essential for establishing the theoretical foundations of systemic thinking in Islamic education system. The concluding fact is that the holistic view of the world is in line with principles of the Islamic worldview which promotes the faith in the Creator through investigation and discovery of His systems in the created world. The author of ‘*Creating the Corporate Future*’ emphasizes this point, saying that:

“I believe we are leaving an age that can be called the Machine Age. In the Machine Age the universe was believed to be a machine that was created by God to do His work. Man, as part of that machine, was expected to serve God’s purpose, to do His will”. (Ackoff 1981, p 6).

To make students aware of their role in this holistic world is essential; but they also must be aware of the different worldviews and ideologies which existing in this big world. For example, commenting on the above statement of Ackoff, a Muslim student should be aware of the fact that nature functions in systematic orders based on the absolute law of God, which known in Islamic tradition as “*Sunnatullah*”. Discovery of the absolute laws of God in His created world is from of worship in Islamic perspective; but the discovery would not be possible without systematic mind and systematic inquiry.

References

- Acikgenc, A. (2006). *The Emergence of Scientific Tradition in Islam*. UK: Foundation for Science, Technology and Civilization (FSTC) Limited.
- Acikgenc, A. (2014). *Islamic Scientific Tradition in History*. Kuala Lumpur: Institute Kefahaman Islam Malaysia (IKIM).
- Ackoff, R.L. (1981). *Creating the Corporate Future*. New York: John Wiley & Sons.
- Ahmad, K. (1980). *Islam: Basic Principles and Characteristics* (publications of World Assembly of Muslim Youth). Retrieved http://www.sultan.org-/books/Islamic_Basic_Principles_and_Characteristics.pdf.
- Al-Asfahani, A. (2007). *Al-dhari`ah ila Makarim al-Shariah*. Cairo, Egypt: Dar al-Salam.
- Al-Faruqi, I.R. (2002). *Al-Tawhid: Its Implications for Thought and Life*. Herndon, Virginia, USA: The International Institute of Islamic Thought.
- Al-Ghazali (1989). *Mizan al-`Amal*. Beirut, Lebanon: Dar al-Kutub al-`ilmiyyah.
- Al-Ghazali (2002). *Ihya’ Ulum al-Din*. Beirut, Lebanon: Dar al-Kutub al-`ilmiyyah.
- Ansari, M.F.R. (2001). *The Qur’anic Foundations and Structure of Muslim Society*. Kuala Lumpur: Islamic Book Trust.
- Attas, S.M.N. (1989). *Islam and the Philosophy of Science*. Kuala Lumpur: ISTAC.
- Bartlett, G. (2001, January). *Systemic Thinking: a Simple Thinking Technique for Gaining (Situation-wide) Focus*. Paper presented at International conference on Thinking Breakthroughs, Auckland.
- Bertalanffy, L.V. (1968). *General System Theory: Foundations, Development, Applications*. One Park Avenue, New York: George Braziller, Inc.
- Bunge, M. (1996). *Finding of Philosophy in Social Science* (Canada: Yale University Press).
- Bunge, M. (2004). How does it work? The search for explanatory mechanisms. *Philosophy of the social sciences*, 34(2), 182-210.

- Dampier, W.C. (1948). *A History of Science and Its Relations with Philosophy and Religion*. Cambridge, UK: Cambridge University Press.
- Dewey, J. (1929). *The Sources of a Science of Education*. New York: Horace Liveright.
- Dewey, J. (1938). *Logic: The Theory of Inquiry*. USA: Henry Holt and Company Inc.
- Dunbar, K., & Fugelsang, J. (2005). Scientific thinking and reasoning. *The Cambridge handbook of thinking and reasoning*, 705-725.
- Golshani, M. (n.d.). Scientific Dimensions in the Qur'an. *Al-Tawhid*, 1(1). Retrieved from <https://www.al-islam.org/al-tawhid/vol5-n1/scientific-dimension-quran-dr-mahdi-golshani>.
- Holyoak, K.J., & Robert G.M. (Eds) (2005). *The Cambridge Handbook of Thinking and Reasoning*. Cambridge, UK: Cambridge University Press.
- Ibn Khaldun, A. (2009). *Al-Muqaddimah*. Beirut, Lebanon: Dar al-Kutub al-`ilmiyyah.
- Iqbal, M. (1996). *Reconstruction of Religious Thought in Islam*. Islamabad, Pakistan: Institute of Islamic Culture.
- Iqbal, M. (2007). *Science and Islam*. USA: Greenwood Press.
- Kuhn, D., & Pearsall, S. (2000). Developmental origins of scientific thinking. *Journal of cognition and Development*, 1(1), 113-129.
- Kuhn, T.S. (1996). *The Structure of Scientific Revolutions*. USA: The University of Chicago Press.
- McLeod, J. (2011). *Qualitative Research in Counselling and Psychotherapy*. London, UK: SAGE Publications Ltd.
- Mele, C., Pels, J., & Polese, F. (2010). A brief review of systems theories and their managerial applications. *Service Science*, 2(1-2), 126-135.
- Mirza, M.R., & Siddiqi, M.I. (Eds.) (1986). *Muslim Contribution to Science*. (Lahore, Pakistan: Kazi Publications.
- Mutahhari, A.M. (n.d.). Understanding the Uniqueness of the Qur'an *Al-Tawhid*, 1(1-3) (Mahliqa Qara'I, Trans). Retrieved from <https://www.al-islam.org/al-tawhid/vol1-n1-3/understanding-uniqueness-quran-ayatullah-murtadha-mutahhari>.
- Mutahhari, M. (1985). *Society and History*. Tahrān: International Relations Department)
- Nasr, S.H. (1984). *Science and Civilization in Islam*. Kuala Lumpur, Malaysia: Dewan Pustaka Fajar.
- Nasr, S.H. (1993). *A Young Muslim's Guide to the Modern World*. Kuala Lumpur- Malaysia: Islamic Book Trust.
- Nasr, S.H. (2010). *Islamic Life and Thought*. Kuala Lumpur, Malaysia: Islamic Book Trust.
- Nidhal G. (2011). *Islam's Quantum Question: Reconciling Muslim Tradition and Modern Science*. London, UK: I. B. Tauris and Co Ltd.
- Perkins, J. L. (2003). Prosperity and the rise and fall of Islam. Retrieved June 12, 2018, from <http://www.faihfreesdom.org/Articles/perkins30325.htm>
- Pickel, A. (2006, July). *Salvaging systems from General Systems theory: Systemic ontology and mechanism-based explanation for the social sciences*. *Proceeding of the ISA XVIth World Congress of Sociology, Durban, South Africa* (pp. 23-29). Doi: <https://www.trentu.ca/globalpolitics-/documents/Pickel062.pdf>.
- Ramalingam, B., Jones, H., Reba, T., & Young, J. (2008). *Exploring the science of complexity: Ideas and implications for development and humanitarian efforts* (Vol. 285). London: Overseas Development Institute.
- Rosenthal, F. (2007). *Knowledge Triumphant: the Concept of Knowledge in the Medieval Islam* (Vol 2). Leiden, Netherlands: Brill.
- Shahid N.K. (2014). Qualitative Research Method: Grounded Theory. *International Journal of Business and Management*, 9 (11), 224-233.
- Shogar, I. (2011). The Scientific Thinking in Islam: Factors of Flourishing and Decline. *Revelation and Science*, 1(2), 1-13.
- Siddiqi, M. (1984). *The Qur'anic Concept of History*. Islamabad, Pakistan: Islamic Research Institute.
- Wartofesky, M.W. (1968). *Conceptual Foundations of Scientific Thought: an Introduction to the Philosophy of Science*. New York: The Macmillan Company.
- Zimmerman, C. (2007). The development of scientific thinking skills in elementary and middle school. *Developmental Review*, 27(2), 172-223.

Article History

Received: 22-08-2017

Accepted: 21-05-2018