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The Scope of the Philosophy of Science: A Review of Philosophical Education

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ABSTRACT

The philosophy of science is a branch of philosophy that discusses the nature of science. The philosophy of science attempts to realize the true truth of the knowledge. This article aims to discuss the scope of the philosophy of science which consists of definition of philosophy, definition of the philosophy of science, characteristics of philosophical thoughts, and three fundamental structures of science. In this study, the researchers employ qualitative method under descriptive approach. Meanwhile, in the present study the researchers used content analysis as the data analysis technique. The results showed that philosophy is a way of humans' thoughts in relation to the study of the fundamental and eternal universe. Furthermore, when philosophy is connected into science, it becomes the philosophy of science. The philosophy of science then is understood as a part of philosophy whose activities to examine science in the context of science through various scientific procedures including initial principles, theoretical structures, measures of scientific truth, views of formal logic, and practical methodology and metaphysics. In addition, philosophy is inseparable from the characteristics of philosophical thoughts which consists of methodical, systematic, coherent and consistent, rational, comprehensive, radical, and univesal. Finally, philosophy examines three aspects of the fundamental structure of science including aspect of ontology, epistemology, axiology. In conclusion, the philosophy of science has four scopes including definition of philosophy, definition of the philosophy of science, characteristics of philosophical thoughts, and three fundamental structures of science.

Keywords: *axiology; epistemology; ontology; philosophy; science*

INTRODUCTION

The term 'philosophy' comes from Greek and Arabic. In Greek, 'philosophy' comes from two syllables, *philos* meaning love and *shopia* meaning knowledge or wisdom. Thus, philosophy means the love of wisdom. Meanwhile, in Arabic the term philosophy comes from wazan *fa'lala*, *fa'lalah* and *fi'lâl* which means to love, to like wisdom and truth (Herianto, 2021, p. 10). In line with the aforementioned definition, both in Greek and Arabic, the term philosophy has the similar meaning, it is 'loving wisdom or truth'. Therefore, a person who learns philosophy is called a philosopher that is a wise person or a person who loves wisdom or truth (Zaprulkhan, 2022, p. 2).

However, nowadays philosophy has shifted meaning when it is viewed from practical point of view, at which when the word 'philosophy' is changed into verb becomes 'to philosophize', it means 'to think'. However, not all the thinking processes can be categorized as philosophize, because what is meant by thinking in the frame of philosophy means thinking deeply and seriously. The purpose of philosophy is to think seriously and deeply to find the nature of truth which is measured by logical and behavioral truth (Herianto, 2021, p. 11; Widyawati, 2013, p. 88).

Recently, philosophy is learnt for all fields of human life including the study of science. It is because, there are similarities between philosophy and science, which subsequently produces a new discipline known as the philosophy of science. In its development, the philosophy of science is variously understood by experts in various definitions in line with the fields of expertise. Meanwhile, in a general sense, the philosophy of science is defined as a branch of philosophy that examines science in terms of characteristics and how to obtain it, as well as what is the effect towards the humans' life. Thus, the philosophy of science is the answer for various questions in relation to science that is learnt and it is sustainably developed by humans in order to find solutions to the problems of life they experienced (Widyawati, 2013, p. 93; Zaprulkhan, 2022, pp. 13–16). Furthermore, the philosophy of science attempts to realize the nature of knowledge's truth. Besides, the philosophy of science involves ways of critical, reflexive, systematic, analytical, synthetic, creative and multi-disciplinary thoughts. These ways of thinking are in accordance with deeply thoughts from the roots, up to the various scientific points of view that existed in the humans' life today (Rahman et al., 2018, p. 5; Soelaiman, 2019, p. 12).

As the objects of the philosophy of science, science refers to everything that exist, whether it looks like the empirical world or does not, such as metaphysics. Meanwhile the formal objects in the philosophy of science are points of view towards the material objects, including the principles used. In the study of the philosophy of science, there is a study of ontology, epithemology, and axiology that complete each other in understanding the nature of science (Soelaiman, 2019, p. 13). Furthermore, the purpose of the philosophy of science is to provide more complete and in-depth understanding towards the nature of science and to find out relationships among the field of sciences concerned. Thus, the purpose of the philosophy of science is to develop science and technology in helping and providing the true prosperity of humans' life (Soelaiman, 2019, p. 14; Zaprulkhan, 2022, pp. 39–40).

Theoretically and practically, the philosophy of science examines 3 (three) fundamental structures of science which include the levels of ontology, epistemology and axiology. Ontology deals with the existence of everything that exist, both in the form of physical and metaphysical reality. Besides, ontology also discusses how its essential existence is and its relationship towards the humans' thoughts. Meanwhile, epistemology deals with the theory of knowledge of how humans acquire knowledge. Finally, axiology deals with the value of science at which the science has value in its development and has a significant effect on humans' life (Rokhmah, 2021, pp. 175–176; Zaprulkhan, 2022, pp. 48–82).

The present study are supported by some previous studies such carried out by Adnyana (2021); Atabik (2014); Muktapa (2021); Rokhmah (2021); Rosa (2023); Rosnawati et al., (2021); and Widyawati (2013). Those previous studies are supported the present study and those are used as the underpinned references of the present study. In addition, this present study entitled: "**The Scope of the Philosophy of Science: A Review of Philosophical Education**".

METHOD

This research uses qualitative method under descriptive approach. Qualitative descriptive is an approach that describes a statement on a problem as carefully as possible (Fraenkel et al., 2012, p. 15). In addition, qualitative descriptive is an approach used to describe a phenomenon as completely and accurately as possible (Hidayat et al., 2022, p. 75, 2023, p. 71).

The data collection technique of the present study is carried out by collecting primary sources in the form of scientific articles retrieved from Google Scholar and the relevant books. Meanwhile, the data analysis technique used in the present study is content analysis (Fraenkel et al., 2012; Hidayat et al., 2023). The content analysis carried out by the researchers consist of 4 stages, namely: (1) selecting the relevant topics available in the scientific articles and books related to the field of the philosophy of science, (2) the selected sources are reviewed according to the topic, (3) compiling the selected sources in accordance with the required chronology, (4) elaborating the selected sources into the sub point of the discussion (Hidayat et al., 2023; Wahyuningsih et al., 2023).

FINDINGS AND DISCUSSION

Based on the content analysis technique carried out by the researchers, it covers 4 stages such explained in details in the research methodology. Those are: 1) selecting the relevant topics available in the scientific articles and books related to the field of the philosophy of science, (2) the selected sources are reviewed according to the topic, (3) compiling the selected sources in accordance with the required chronology, (4) elaborating the selected sources into the sub point of the discussion (Hidayat et al., 2023; Wahyuningsih et al., 2023). The analysis based on the 4 stages aforementioned is written in the following table.

Table 1: Selecting the relevant topics available in the scientific articles and books related to the field of the philosophy

No.	The authors' name	Year published	Title of the article/book	Name of journal, vol., & No./publisher
1.	Setya Widyawati	2013	Filsafat Ilmu Sebagai Landasan Pengembangan Ilmu Pendidikan	Gelar: Jurnal Seni Budaya, 11(1)
2.	Ahmad Atabik	2014	Teori Kebenaran Perspektif Filsafat Ilmu: Sebuah Kerangka Untuk Memahami Konstruksi	Jurnal Fikrah, 2(1)

			Pengetahuan Agama	
3.	Paulus Wahana	2016	Filsafat Ilmu Pengetahuan	Penerbit Pustaka Diamon
4.	Darwis A. Soelaiman	2019	Filsafat Ilmu Pengetahuan: Perspektif Barat dan Islam	Penerbit Bandar Publishing
5.	Edy Herianto	2021	Buku Ajar Filsafat Ilmu	Penerbit Yayasan Nusatenggara Centre Mataram
6.	Dewi Rokhmah	2021	Ilmu dalam Tinjauan Filsafat: Ontologi, Epistemologi, dan Aksiologi	CENDEKIA: Jurnal Studi Keislaman, 7(2)
7.	Zaprulkhan	2022	Filsafat Ilmu, Sebuah Analisis Kontemporer	Penerbit Rajawali Grafindo Persada
8.	Andi Rosa	2023	Integrasi Filsafat dan Ilmu Sosial Holistik dalam Menafsirkan Al- Qur'an	Aqlania: Jurnal Filsafat dan Teologi Islam, 14(1)

Source: (Data, 2024)

Table 2: Compiling the selected sources in accordance with the required chronology

No.	Selected topic	Sources
1.	Definition of philosophy	Soelaiman (2019); Widyawati (2013)
2.	Definition of the philosophy of science	Widyawati (2013); Wahana (2016); Rosa (2023)
3.	Characteristics of philosophical thoughts	Atabik (2014); Zaprulkhan (2022)
4.	Three fundamental structures of science	Rokhmah (2021); Zaprulkhan (2022)

Source: (Data, 2024)

In these findings and discussion sessions, the researchers explain the sub point of discussion that consists of (1) definition of philosophy, (2) definition of the philosophy of science, (3) characteristics of philosophical thinking, and (4) three fundamental structures of science. Those sub points of the discussion are explained as follow.

Definition of Philosophy

Philosophy comes from the ancient Greek which is derived from two words '*philo*' meaning 'love', and '*sophia*' meaning wisdom. Thus, philosophy etymologically means 'love of wisdom' (Soelaiman, 2019, p. 6). Furthermore, people who learn philosophy and love of wisdom are called as philosophers (Zaprulkhan, 2022, p. 2). Linguistically, the word philosophy is interpreted variously depending on the point of view of philosophers who learn philosophy from various different scientific points of view. Here are some various definitions of philosophy in terms of the philosophers' opinions.

1. Socrates (468-399 BC) argues that philosophy is the study of the universe which then focus on investigating ourselves (Widyawati, 2013, p. 88).

2. Plato (427-347 BC) argues that philosophy is the study of fundamental and eternal things (Widyawati, 2013, p. 88).
3. Al-Kindi (790-873 AD) a Muslim philosopher in the 8th century AD, argues that philosophy is a noble science and includes the science of divinity, the science of oneness, and the science of all ways of reaching *maslahat* and avoiding *madharat*. According to him, the highest philosophy is religious philosophy, God is not a species, but a creator who is absolute oneness (Soelaiman, 2019, p. 7).
4. Al Farabi (870-950 M) a Muslim philosopher in the 9th century AD, argues that philosophy as the nature of science is *maujud*, and also refers to its true nature (Soelaiman, 2019, p. 7).
5. Immanuel Kant (1724-1804 M) a Western philosopher who lived in the 18th century AD, argues that philosophy as the main science and the basis of the whole knowledge includes four problems: (a) Metaphysics (what can be known), (b) Ethics (what can be done), (c) Religion (to what extent is man's hope?), and (d) Anthropology (what is man?) (Widyawati, 2013, p. 88).

Based on the whole definitions aforementioned, those can be concluded that philosophy is a way of humans' thoughts to study the fundamental and eternal universe and also themselves. In addition, philosophy is also understood as the science of nature and the truth of nature, so that philosophy becomes a noble branch of science that includes divinity, oneness, and the science of all ways to achieve *maslahat* and avoid *madharat* in the world and hereafter.

Definition of the Philosophy of Science

After highlighting the definition of philosophy, the researchers need to highlight definition of the philosophy of science, because philosophy is closely related to science. Even in one of the definitions of philosophy aforementioned, philosophy is interpreted as science. To make it easy to understand, the philosophy of science is variously defined based on the philosophers who study the science. Here are some various definitions of the philosophy of science that can be presented as follow.

1. Peter Caws argues that the philosophy of science as a part of philosophy which examines science in the context of the overall humans' experience (Widyawati, 2013, p. 93).
2. Steven R. Toulmin argues that the philosophy of science as a discipline of science that is discussed from the scientific research procedures, determination of arguments, and metaphysical assumptions in order to assess the basis of validity of science from the point of view of formal logic, practical methodology, and metaphysic (Widyawati, 2013, p. 93).
3. The Liang Gie argues that the philosophy of science is reflective thoughts on questions concerning the nature of the foundations of science including basic concepts, basic assumptions, initial principles, theoretical structures, and measures of scientific truth (Widyawati, 2013, p. 93).
4. The philosophy of science is a part of the study which examines the nature of science and the philosophical foundation of science (Wahana, 2016, p. 40).

5. The philosophy of science is a part of philosophy that examines the nature of science in accordance with the limitations of the discipline itself, so that the philosophy of science becomes an understanding of natural phenomena as the object of science (Widyawati, 2013, p. 94).

Based on the various definitions related to the philosophy of science aforementioned, those can be concluded that the philosophy of science is a part of philosophy whose activities to examine science through various scientific procedures including initial principles, theoretical structures, measures of scientific truth, view of formal logic, practical methodology, and metaphysic.

Furthermore, a basic understanding of the philosophy of science is expected to be useful to provide direction and basis of thoughts. According to Sutan Takdir Alisyahbana, the condition of philosophy is to think carefully and based on definite rules. Questions related to thinking philosophically, it includes; Who am I?, where did I come from, what was I created for, why was I created, what was I created for, how I was created. In addition, human existence from science is a manifestation of curiosity towards the nature of everything. The existence of science as a product of thoughts is a light to find the identity, understand the existence of useful life (Rosa, 2023).

Further, in general the relationship between the philosophy of science and philosophy can be seen from various factors. These factors can be mapped in a scientific structure as presented in the following table.

Table 3: The differences between science and philosophy

Science	Philosophy
Studying limited fields	Comprehensive and inclusive manner
Science is more analytical and descriptive in its approach	Synthetically and synopsis
Science uses observation, experiment and data classification, as well as sensory experience	Asking question, why and how in questioning the relationship between specific facts with the broader scheme of problem
Attempting to discover laws of phenomena	Studying the relationship between scientific findings and religious, moral, and artistic claims
The truth is measured by the experience	The truth is measured by thoughts

Source: (Widyawati, 2013, p. 92)

Referring to the descriptions aforementioned, those can be concluded that philosophy is closely related to science and vice versa. The fact can be seen from the basic study of philosophy and science which examine both limited and universal phenomena, or questioning the relationship between specifically facts with the broader scheme and the expression based on experience or thoughts.

Characteristics of Philosophical Thoughts

The thoughts of philosophy have its own characteristics. In general, there are 7 (seven) characteristics of philosophical thoughts (Atabik, 2014; Zaprulkhan, 2022). The

seven characteristics include (1) methodical, (2) systematic, (3) coherent and consistent, (4) rational, (5) comprehensive, (6) radical, and (7) univesal. The seven aforementioned characteristics are described as follows.

1. Methodical, based on prevalent method or way in the process of thoughts;
2. Systematic, based on the thoughts in relation to the existing elements, so that it results the systematic mindset;
3. Coherent and consistent, based on the rules of logical thoughts, the elements should not contain contradictive both logical and clear descriptions;
4. Rational, based on the rules of correct and logical thoughts;
5. Comprehensive, based on the thoughts about something from various points of view which means it is universal in explaining the whole universe;
6. Radical, based on the deeply thoughts towards the problem; and
7. Univesal, based on the leading to the worldly view in the form of humans' general experience.

Based on the aforementioned explanation, it can be concluded that the characteristics of philosophical thoughts consist of 7 (seven). The seven characteristics include: (1) methodical, (2) systematic, (3) coherent and consistent, (4) rational, (5) comprehensive, (6) radical, and (7) univesal (Atabik, 2014; Zaprulkhan, 2022).

Three Fundamental Structures of Science

Regarding to the philosophy of science, there are three aspects of the fundamental structure of science. The three aspects include ontology, epistemology and axiology. Ontology refers to the existence of everything, both in the form of physical and metaphysical reality. Ontology also refers to how its essential existence and its relationship between science and thoughts. Epistemology refers to the theory of knowledge of how humans acquire knowledge. Meanwhile, axiology refers to the value of science at which the science has value in its development and has a significant effect on humans' life (Rokhmah, 2021, pp. 175–176). Furthermore, the researchers need to discuss in detail related to three aspects of the fundamental structure of science. The discussion is as follows.

a. Aspect of ontology

Linguistically, ontology comes from the Greek '*ontos*' meaning 'that exists', and '*logos*' meaning 'science'. Thus, ontology is the study of something exists. As for its terms, ontology is a branch of philosophy that refers to the nature of life due to an existence which includes the existence of everything and everything may exist (Rokhmah, 2021, pp. 176–177). In the study of the philosophy of science, ontology focus on science itself. The ontology of the philosophy of science has 8 (eight) characteristics. Those characteristics are as follows.

1. Science comes from research results;
2. Science is closely related to the existence of empirical concepts of knowledge;
3. Science is rational, objective, systematic, methodological, observative, and neutral;
4. Science is subject to the principles of verification, explanation, openness and repeatability, radical scepticism, and various experimental methods;

5. Science has evidence in the form of causality and applied science into technologies;
6. Science recognizes relative knowledge and concepts as well as scientific logics;
7. Science has various hypotheses and scientific theories; and
8. Science has a proven concept of natural laws.

b. Aspect of epistemology

Linguistically, epistemology comes from the Greek '*episteme*' which means 'knowledge' and '*logos*' which means 'science'. As for its terms, epistemology is a science that refers to the source of knowledge, method, structure, and whether a science is true or not. Epistemology is a branch of philosophy that refers to the nature and scope of knowledge, basic structure, and affirmation that a person has knowledge (Rokhmah, 2021, p. 180).

Furthermore, epistemology is closely related to the scientific method as a tool to express the working of mind activity. Because the scientific method is the legal basis that determines whether knowledge is feasible or not to be the science. Thus, epistemology has a very important function in building science. Then, in epistemology the scientific method is divided into two parts of thinking patterns, namely:

1. Deductive thinking pattern is the thinking pattern which gives rational and consistent properties to previously existing scientific knowledge. This pattern of thinking examines the thoughts activities based on various existing scientific theories and hypotheses which are made for testing and proof.
2. Inductive thinking pattern is the thinking pattern which gives rational and consistent properties to scientific knowledge in revealing the phenomena around them. The phenomenon is then analyzed to produce objective and empirical descriptions and concepts.

c. Aspect of axiology

Linguistically, axiology comes from the Greek '*axion*' which means 'value' and '*logos*' which means 'science'. As for its terms, axiology is the science of value which essentially examines the relationship between science and value, whether science is value-free or value-bound. Because it is related to value, axiology is closely related to good and bad, closely related to worthy and unworthy. Thus, when scientists want to investigate and create a type of science, they actually have to do an axiological test, so that the science is tested for feasibility (Rokhmah, 2021, p. 182).

In the rules of the philosophy of science, science axilogically provides benefits to anticipate the development of humans' life, so that science sustainably run on the path of humanity. Thus, the axiology of science is measured based on the working power of science which includes three factors, namely:

1. The working power of science is to maintain and give direction, so that the scientific process can find the ultimate truth. Thus, scientific behavior needs to be carried out with honesty and not oriented on pragmatic and transactional interests.
2. The working power of science is the selection of objects which is ethically carried out. Thus, science is maintained not to change humans' nature, not to degrade humans' dignity, not to interfere the problems of humans' life, and to be neutral from dogmatic values, arrogance of power, and political interests.

3. The working power of science is for the development of knowledge directed in order to improve the standard of humans' life that always pays attention to humans' nature and dignity. In addition, science should also be used in order to maintain the balance and sustainability of nature universally through various usage of science and research findings.

In addition, to discuss ontology, epistemology, and axiology as three aspects of the fundamental structure of science, the philosophy of science also discusses the object of science. Based on the study of the philosophy of science, these objects are divided into 2 (two) types, namely: material objects and formal objects. Both objects are found in every science including philosophy. Material objects are materials that are investigated, viewed, or highlighted by a scientific discipline that includes anything to concrete or abstract. Formal objects are a way of looking at material objects including the principles used (Zaprulkhan, 2022, pp. 48–82).

Based on the aforementioned explanation, it can be concluded that aspects of the fundamental structure of science are based on 3 (three) main studies, namely: (1) ontology, (2) epistemology, and (3) axiology. In addition, the three aspects of the fundamental structure of science, the philosophy of science also discusses the object of science which is divided into 2 (two) types, namely: material objects and formal objects. The three aspects of the fundamental structure of science and the two objects of science are studied and complete each other in understanding science and the philosophy of science.

CONCLUSION

Based on the aforementioned discussion, it comes into the conclusion that philosophy is a way of humans' thoughts in relation to the study of the fundamental and eternal universe. Furthermore, when philosophy is connected into science, it becomes the philosophy of science. The philosophy of science then is understood as a part of philosophy whose activities to examine science in the context of science through various scientific procedures including initial principles, theoretical structures, measures of scientific truth, views of formal logic, and practical methodology and metaphysics. In addition, philosophy is inseparable from the characteristics of philosophical thoughts which consists of methodical, systematic, coherent and consistent, rational, comprehensive, radical, and univesal. Finally, philosophy examines three aspects of the fundamental structure of science including aspect of ontology, epistemology, axiology.

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