



## The Contribution of the Philosophy of Science to Scientific Research and Social Life

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### ABSTRACT

The existence of the philosophy of science becomes crucial in facing the advancements in science and technology, marked by the increasing specialization in various fields. The philosophy of science serves as a theoretical framework and research methodology closely related to the scientific research process. It addresses the essence of science, which forms the basis for logical assumptions (neutralistic ethical doctrines), empirical results, and the limitations of scientific knowledge. This article employs a qualitative approach, utilizing library research by examining relevant literature related to the discussed study. It also incorporates document studies of previous research results associated with the philosophy of science. Data collection involves exploring books, reputable scientific journals, and sources from Google Scholar, digital libraries, and others. Through its ability to test, contemplate, and critique assumptions and scientific methods, the philosophy of science also plays a role as a logical foundation for research methodology. In the context of higher education, the philosophy of science provides a solid foundation for scholarly pursuits, offering a logical basis for research methodology, and enhancing understanding of what is referred to as science. The contribution of the philosophy of science to research methodology not only broadens cognitive horizons but also provides a profound understanding expected to motivate researchers to genuinely engage in their research tasks.

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### 1. INTRODUCTION

The philosophy of science is a branch of philosophy that explores the fundamental aspects of science. In this field, science is dissected and questioned from various perspectives, including the sources of knowledge, the tools or instruments used to acquire knowledge, the processes or methods that give rise to science, and the criteria of validity employed to assess the truth or error of a body of knowledge.

The exploration of science began in ancient Greece, notably through the contributions of Plato (428-348 BC), who was a disciple of Socrates (469-399 BC). Plato's thinking can be linked to the efforts of philosophers at that time to discover and formulate the "first principle" (arkhe) of everything, or the essence that we might now recognize as atoms. For example, pre-Socratic philosophers like Thales, who asserted that the first principle of life originated from water, Democritus and Anaximenes, who stated that arkhe came from air, and Heraclitus, who formulated that arkhe originated from everything constantly changing, the 'process of becoming,' along with various other philosophical formulations on this concept. The shift in Greek thought from the era of myths towards logos also began to emerge, as described by C. Verhaak [1]. After the era of natural philosophy before Socrates, the figure of Plato emerged as a disciple of Socrates. Plato initiated the formulation of the concept of knowledge or epistemology using the term "episteme" (knowledge), where, according to him, true knowledge originates from the world of Forms. This concept laid the foundation for the

formulation of knowledge by subsequent philosophers, such as Aristotle, who criticized Plato's theory of Forms. Aristotle asserted that everything known by humans comes from the external world and is then processed through the process of abstraction from the senses [2].

The discussion on the philosophy of science began to spread widely in the early 20th century. Nevertheless, a crucial role in the development of philosophy of science, in general, can be attributed to the Western philosopher Francis Bacon, who, with the inductive method he presented in the 19th century, is considered the foundation of the philosophy of science. Some philosophers believe that the increased attention to the role and function of the philosophy of science emerged primarily when science and technology (S&T) experienced rapid advancements. In this context, some scientists, philosophers, and even religious leaders began to express concerns that the progress of science and technology could threaten the sustainability of humanity and the natural environment. This threat arises because the development of science and technology sometimes proceeds autonomously, detached from its philosophical foundations. The presence of the philosophy of science is considered an effort to reset its role and redirect it according to its original purpose, which is based on human well-being. This is deemed highly important, as emphasized by various groups, including religious leaders [3]. This is one of the contributions in the discussion of the main topics of the philosophy of science.

This article aims to examine the Contribution of the Philosophy of Science in Scientific Research and Social Life. The philosophy of science, as a theoretical framework and research methodology, is interconnected with scientific research. It elucidates the essence of science, serving as the foundation for logical assumptions (neutralistic ethical doctrines), achieved empirical results, and the limitations of scientific capabilities. On the other hand, research methodology explains the efforts to advance knowledge based on scientific methods, comprising both deductive and inductive approaches.

So, what is the contribution of the philosophy of science to scientific research? What role does the philosophy of science play in theory development in scientific research? And how does it contribute to social life?.

## 2. RESEARCH METHODS

This article is written using a qualitative approach, employing library research by examining relevant literature related to the discussed study. Additionally, it utilizes document studies of previous research results associated with the philosophy of science. Data collection is conducted by reviewing reading materials, reputable scholarly journals, and sources from Google Scholar, digital libraries, and others.

## 3. RESULTS AND DISCUSSION

### History and Development of Philosophy of Science

This exposition will discuss the history of the development of the philosophy of science, which will be classified into four developmental phases, as follows:

#### 1) Philosophy of Science in the Ancient Greek Era

The issues of the philosophy of science were first discussed in Ancient Greek thought. In Miletus, a city that gave birth to natural philosophers seeking the arche (origin of life) such as Thales, Anaximander, Heraclitus, Anaximenes, and others. The thought of these natural philosophers had distinct characteristics and methods, which then continued to develop in subsequent periods.

It was Plato (427-347 BC) who is known as the first person to address the issues of knowledge. He was later followed by Aristotle (384-322 BC), who developed principles of logic. This marks the roots of the first systematic philosophy of science. Plato argued that the results of sensory observation do not provide reliable knowledge due to their constantly changing nature. Because of this variability, Plato did not trust their truthfulness. Knowledge derived from the senses was doubted in its correctness. Only something unchanging could serve as a guide for a source of knowledge. In his quest, Plato discovered that beyond (outside the realm of sensory observation), there existed something he called "Forms" or "Ideas." This world of ideas is permanent, unchanging, and eternal [4] Plato also argued that the sensory world is not the true reality; humans are born with innate ideas. With these innate ideas, humans can recognize and understand everything, giving rise to knowledge. Plato emphasized that individuals merely "recall" these innate ideas if they want to comprehend everything [4].

Plato's ideas were later criticized by Aristotle, who argued that innate ideas do not exist. While Plato emphasized the existence of a world of "Forms" beyond concrete (empirical) objects, Aristotle did not acknowledge the existence of such a world [2]. Universal laws and understanding, according to Aristotle, are not innate but are attained through a lengthy process of empirical human observation. Aristotle referred to this process as "abstraction," as stated by Abdullah. Aristotle acknowledged that sensory observations are variable, not fixed, and not eternal. However, through continuous observation and investigation of concrete things and objects, reason or intellect can detach or abstract its ideas from these

concrete objects. From this, universal ideas and laws arise, formulated by human reason or intellect through the process of sensory observation and experience, as expressed by Abdullah [4].

## 2) Philosophy of Science in the Renaissance Era

Entering the Renaissance period, marked by the emergence of rationalist thought, where Reason is considered the sole source of knowledge. Rationalists believe that knowledge, and often the only source of it, comes solely from the intellect, as they argue that the senses often make mistakes. Therefore, the senses cannot be relied upon as a valid source of knowledge; only by using specific procedures of reason can we attain true knowledge. For them, intellect alone is sufficient to provide understanding, regardless of the senses.

17th-century rationalism had several central figures such as René Descartes (1596-1650), G. W. Leibniz (1646-1716), Christian Wolff (1679-1754), and Baruch Spinoza (1632-1677). Most of these figures hailed from continental Europe, hence Rationalism is better known as continental philosophy. Among these figures, Descartes is a central philosopher when discussing rationalism in-depth and comprehensively. René Descartes, a French philosopher, is often dubbed the "father of modern philosophy" and laid the foundation for the rationalist movement. Empiricism emerged in the 17th century, often referred to as atomistic empiricism because it understands knowledge as sensory data that is isolated, unrelated, and stored in the human mind. Empiricism appeared at the end of the Renaissance through the thoughts of Francis Bacon, particularly when he explained his inductive method. However, it was only in the philosophy of Thomas Hobbes (1588-1679), John Locke (1632-1704), George Berkeley (1685-1753), and David Hume (1711-1776) that experiences, whether sensory or mental, became the central focus of reflection. Therefore, these four philosophers are referred to as pioneers of empiricism, a stance that is prevalent in the modern era of science and technology, as expressed by [1].

Empiricists consider that there is no source of knowledge other than our experiences. Thus, primarily, it is the senses and not reason that play a crucial role by providing us with direct experiences of specific objects. This significant role is attributed to the following reasons: First, all propositions we make result from reports of experiences or are inferred from experiences. Second, we cannot have any concepts or ideas about something unless they are based on what is gained from experience. Third, reason can only function when it has reference to reality or experience. Therefore, for empiricists, reason merely combines sensory experiences to attain knowledge. Thus, without sensory experience, no knowledge is acquired.

The next philosophical movement in the philosophy of science is Kantianism, which is a philosophical doctrine developed by the German philosopher Immanuel Kant. Kant himself referred to his philosophy as the Copernican revolution in philosophy. He argued that he successfully reconciled the centuries-old debate between empiricism and rationalism camps [1]. With this synthesis, Kant produced a new philosophical approach that served as a foundation in subsequent history. Kant's ideas have proven to be highly significant and influential in the history of philosophy.

## 3) Philosophy of Science in the Modern Era (Positivism)

Entering the 19th century, the development of the philosophy of science entered the era of positivism. Positivism is a philosophical movement characterized by an evaluation of science and scientific methods. In the 20th century, notable figures in positivism formed a group known as the Vienna Circle, including Gustav Bergman, Rudolf Carnap, Philip Frank, Hans Hahn, and others.

As the 20th century unfolded, the development of the philosophy of science entered a new era, where the stage of the philosophy of scientific knowledge was dominated by the logical positivism or what is called Logical Empiricism. This movement emerged and was developed by the Vienna Circle. Logical empiricism represents an extreme form of empiricism, limiting experience to what can be observed and expressed in language. Logical empiricism faced strong reactions from pragmatists, also known as radical empiricists. Radical empiricism rejects the limitation of experience to what can be sensed alone. The experience understood by radical empiricism encompasses all experiences arising from various events that humans, as sentient beings with thought, feeling, and will, undergo in their interactions with objects in their surrounding environment [5]. Therefore, what cannot be traced sensorially is considered not knowledge. Radical empiricism is also often referred to as sensationalism. However, not all adherents of empiricism follow sensationalism [6].

## 4) Philosophy of Science in the Contemporary Era

The development of the philosophy of science in this era is marked by the emergence of philosophers who bring new perspectives to its progression up to the present day. The arrival of Karl Raymund Popper (1902-1959) stands out as a new chapter and a transitional period towards an era later referred to as the new philosophy of scientific knowledge. According to Langaji [7], this is due to several reasons. Firstly, through his falsification theory, Popper became the first person to challenge and break the dominance of logical positivism from the Vienna Circle. Secondly, with his views on learning from the histories of sciences, Popper introduced a new era of philosophy of science, which would be further developed by the subsequent philosopher, Thomas Kuhn.

New figures in the philosophy of science include Thomas S. Kuhn, Paul Feyerabend, Imre

Lakatos, and other philosophers. They share a common interest in the history of science and the role of history in the efforts to understand and construct the true face of science and scientific activities. This phenomenon is also referred to as a rebellion against positivism.

### Understanding the Philosophy of Science

There are various definitions of the philosophy of science compiled by Gie [8], and here are four opinions considered most representative:

- 1) Robert Ackermann: The philosophy of science is a critical examination of current scientific opinions compared to previously proven opinions.
- 2) Lewis White Beck: The philosophy of science questions and evaluates scientific thinking methods, attempting to establish the value and significance of scientific endeavors as a whole.
- 3) Cornelius Benjamin: The philosophy of science is a branch of philosophical knowledge that systematically examines the fundamental nature of science, its methods, concepts, assumptions, and its place within the general framework of intellectual knowledge.
- 4) May Brodbeck: The philosophy of science is an ethically and philosophically neutral analysis, depiction, and explanation of the foundations of science.

The four definitions above illustrate the scope or coverage addressed within the philosophy of science, including, among others: Critical comparison of the history of scientific development; The fundamental nature of science; Scientific methods; Scientific assumptions; Ethical attitudes in the development of scientific knowledge. Among these factors, the most extensively discussed are the history of scientific development, scientific methods, and ethical attitudes in the development of scientific knowledge [3].

The history of scientific development presents various discourses that evolve around scientific discoveries in accordance with different periods. Each period exhibits its own distinct characteristics, so a critical comparison between one period and another will reveal the richness of scientific paradigms throughout the history of development. Kuhn even asserts the occurrence of scientific revolutions supported by the discovery of new paradigms in specific fields, capable of transforming societal thought patterns. For example, during the Greek era until the Middle Ages, society adhered to a Geocentric view, considering the Earth as the center of the universe. However, after the Copernican revolution, society came to believe that it is not the Earth but the Sun that serves as the center of the universe, leading to a paradigm shift from geocentric to heliocentric.

The ethical stance in the development of science is one of the crucial issues in the philosophy of science, particularly in addressing the question of whether science is value-free or not. In the development of scientific knowledge, there are two opposing camps: one that believes science should be value-free (for example: Positivism), and another that argues scientists cannot be value-free as they are always tied to social interests. In connection with the definition, the philosophy of science can be understood as a fundamental and critical reflection on the nature of science itself. A. Cornelius Benjamin defines the philosophy of science as follows: "That philosophic discipline which is the systematic study of the nature of science, especially of its methods, its concepts and presuppositions, and its place in the general scheme of intellectual disciplines" [8]. The philosophy of science is a branch of philosophy that systematically examines the fundamental nature of science, its methods, concepts, assumptions/prejudices, and its position within the general framework of various branches of scientific knowledge [8]. Based on a collection of definitions cited by him, it can be formulated that the philosophy of science discusses the foundations of science, including basic concepts, fundamental assumptions, foundational principles, theoretical structures, and criteria for scientific truth [8].

### Aims of Philosophy of Science

According to Bakhtiar [9], some descriptions of the aims of the philosophy of science are as follows:

- 1) Delving into the fundamental elements of science so that we can comprehensively understand the sources, essence, and goals of science.
- 2) Understanding the history of the growth, development, and progress of science in various fields, providing an overview of the contemporary scientific process historically.
- 3) Serving as a guide for professors and students in studying at universities, especially to distinguish between scientific and non-scientific issues.
- 4) Encouraging aspiring scholars and scientists to consistently delve into and develop their knowledge.

Asserting that there is no contradiction between the sources and goals of science and religion. Another opinion on the Purpose of the Philosophy of Science according to [3] as a specialized branch of philosophy that discusses the history of the development of science, scientific methods, and the ethical attitudes that scientists should develop generally contain the following objectives:

- 1) Philosophy of science as a means of testing scientific reasoning, so that individuals become critical of scientific activities. It means that a scientist must have a critical attitude towards their own field of study, thus avoiding a solipsistic attitude, believing that only their opinion is the most accurate.
- 2) Philosophy of science is an effort to reflect on, test, and criticize the assumptions and methods of science. Because the tendency among modern scientists is to apply a scientific method without paying attention to

the structure of the body of knowledge itself. A necessary attitude here is to apply a scientific method that is suitable or compatible with the structure of the body of knowledge, not vice versa. The method is just a means of thinking, not the essence of science.

- 3) Philosophy of science provides a logical foundation for scientific methods. Every scientific method developed must be logically and rationally justifiable so that it can be understood and used universally. The broader the translation and use of scientific methods, the more valid the method is. Discussions about this are addressed in methodology, which is the science that studies the ways to obtain the truth.

Aspects that become the main focus in the discussion of the philosophy of science include the following:

- 1) Study of: concepts, assumptions, and methodologies of science; analysis of concepts and language used; and extension and reconstruction for more consistent applications in acquiring knowledge.
- 2) Study and justification of the conclusion-drawing processes used in science and its symbolic structure.
- 3) Study of the diversity of scientific fields and their interrelated nature, similarities, differences, and paradigm issues.
- 4) Study of the consequences of scientific knowledge for our perception of reality, understanding of natural phenomena; the relationship of logic and mathematics to reality, the status of theoretical entities; sources of knowledge and their validity; the relationship of science to the subject (scientist) and values (ethics, aesthetics). (The relationship between science and values, especially moral values (ethics), has become a topic of much interest recently. When the negative impacts of the application of science and technology on humans and the environment are felt, it is realized that science and technology require moral rules (scientific ethics, professional ethics) that can be used as guidelines to determine the goodness and badness of an action.)
- 5) Analysis of various concepts and problems commonly used in scientific methods, such as: facts, evidence, axioms, principles, postulates, observations, descriptions, explanations, concepts, clarifications, models, hypotheses, theories, laws of deduction, induction, causality, verification, falsification, probability, and others. These terms are found in the discussion of methodology [10].

In the above discussion, the philosophy of science can also be referred to as the reflection of the second stage (secondary reflection). It involves critical and radical thinking about various scientific aspects. This second-stage reflection is evidence of philosophy's loyalty to the "curiosity attitude" by questioning the basic assumptions, concepts, and theories produced in various scientific fields, leading to the development of what we call: philosophy of social science, political philosophy, economic philosophy, legal philosophy, philosophy of communication, philosophy of language, philosophy of technology, and so on.

To establish the foundation of understanding philosophy of science, Cony [11] explains four perspectives in the philosophy of science: (1) Philosophy of science is the formulation of a world view consistent with important scientific theories. According to this view, it is the philosopher's task to elaborate the broad implications of science. (2) Philosophy of science is an exposition of the presuppositions and predispositions of scientists. (3) Philosophy of science is a discipline in which concepts and theories about science are analyzed and classified. (4) Philosophy of science is a second-order guideline, demanding answers to questions such as: (a) What characteristics distinguish scientific inquiry from other types of inquiry? (b) Under what conditions should scientists conduct natural investigations? (c) What conditions must be met for a scientific explanation to be considered true? (d) What is the cognitive status of scientific principles and laws? According to Wibisono [12], philosophy of science, as a continuation of the development of the philosophy of knowledge, is also a branch of philosophy. Every form of knowledge has three components that serve as the pillars of the structured body of knowledge. These components are ontology, epistemology, and axiology. Ontology addresses questions of how, and axiology addresses questions of purpose.

### **Characteristics of Philosophical Thought of Science**

Philosophy, in accordance with its fundamental characteristics as the principle and foundation of thinking for every human endeavor to understand and develop its existence, fulfills its task based on several features of thought. *First*, Rational Thinking: Philosophical thinking involves rationality. However, not all thinking activities and their results can be categorized as philosophical. The first characteristic of philosophical thinking must primarily be rational, not based on subjective feelings, mere imagination, or fantasy. The rational characteristic of thinking indicates that both thinking activities and the results of philosophical thinking must be acceptable in common sense, not merely following a common belief. *Second*, Radical Thinking (radix = root): This means philosophical thinking that aims to delve into and fathom reality or ideas to their roots, to discover and elevate the fundamental aspects of such thinking, resulting in profound and fundamental thinking. *Third*, Creative and Innovative: This means that philosophical thinking is not thinking that perpetuates itself within various constraints of static dogma or ideology. On the contrary, it constantly strives to break free from the stagnation of inspiration, to criticize, improve, refine, and develop itself, thus giving rise to new inventions and ideas that are more brilliant, open, and competitive in responding to the demands of the times.

*Fourth*, Systematic and Analytical Thinking: This means that the characteristic of philosophical

thinking is always logical (structured and organized based on the laws of correct thinking). Philosophical thinking does not merely release or arrange ideas, reasoning, and creative faculties arbitrarily (sporadically). On the contrary, philosophical thinking always seeks to classify or categorize, synthesize (compile) or accumulate, and reveal the deepest meaning of thoughts, assembling and arranging them with words (meanings), sentences (decisions), and proofs (conclusions) through precise and correct systems of reasoning. *Fifth*, Universal Thinking: This means that philosophical thinking always seeks ideas that are universal, applicable everywhere. Philosophical thinking will never stop at a limited reality; it will break through to find ideas that are global in nature and become references for general thinking. *Sixth*, Comprehensive and Holistic: This means that philosophical thinking is always comprehensive and whole. For philosophy, the whole is clearer and more meaningful than the parts. Holistic means thinking in a comprehensive manner, not detached in narrow sectoral egotism.

*Seventh*, Abstract Thinking: Abstract thinking is thinking at the level of ideas, concepts, or notions. This means that philosophical thinking always strives to elevate the level of thinking from mere factual statements about limited physical facts, within the constraints of human sensory reach, to place it on a foundation of comprehensive, integral (focused), and mutually complementary understanding at an abstract level through forms of ideas, concepts, or thought notions. *Eighth*, Reflective Thinking: This means that philosophy always thinks with careful consideration and interpretation for the discovery of the meaning of truth in a comprehensive and profound way. The characteristic of reflective philosophical thinking aims to show that philosophical thinking does not tend to justify itself but is always open to criticism and deep reflection. It repeatedly and thoroughly contemplates while seeking the deepest essence of the intended thought, also discovering its complete connections with the broad and problematic core of human life.

*Ninth*, Humanistic Thinking: The characteristic of philosophical thinking aims to place the essence of thought on values and human interests as the point of orientation, development, and control of thought itself. This means that thinking and all its derivatives, whether in the form of knowledge, science, or technology, should be able to demonstrate a responsibility to a real human task. *Tenth*, Contextual Thinking: This characteristic of thinking aims to show that the mind is not just an idea but a reality of existence, with its real and clear context. This means that every philosophical thought always grows and develops in the real context of human life. Philosophical thinking, therefore, is a part of the way humans or societies think and act to navigate and solve real-life problems. *Eleventh*, Existential Thinking: The characteristic of philosophical thinking aims to show that thought is human thought. Thought itself is a sign of existence or existential phenomena, and through thought, humans cultivate themselves and fulfill their existential nature with dignity.

### Implications of Studying the Philosophy of Science

Methodological clarification in the philosophy of science has repeatedly brought creative advancements to the science itself, thereby generating new experiences that philosophers can utilize to advance their methodological analyses, according to Raverts [13].

- 1) For someone studying the philosophy of science, adequate basic knowledge of both natural and social sciences is required so that scientists have a strong foundation. This means that social scientists need to study natural sciences broadly, and similarly, a natural scientist needs to have a broad understanding of social sciences. This way, different fields of science can complement each other, and harmonious collaboration can be established to address human-related issues.
- 2) It raises awareness for a scientist not to fall into the trap of the "ivory tower" mentality, which involves pure thinking within their field without linking it to the realities outside. However, almost every scientific activity cannot be separated from the context of socio-cultural life.

### Understanding Scientific Research

Before discussing the contribution of the philosophy of science to scientific research, several points about the understanding of scientific research will be outlined first:

- 1) Research (scientific inquiry) is a systematic process that involves the collection and analysis of information (data) to enhance understanding of an interesting phenomenon [14]. Another definition by Dane [15] states that research is a critical process of posing questions and attempting to answer questions about facts in the world.
- 2) Research is a process to achieve answers to a question, the resolution of problems related to a systematic and factual phenomenon. The process in research is encapsulated in research methodology, which has eight characteristics as outlined by Djunaidi [16]: (a) Research begins with a question or problem. (b) Research requires a clear statement of objectives. (c) Research follows a specific procedural design. (d) Research typically divides the main problem into more manageable sub-problems. (e) Research is guided by specific problems, questions, or hypotheses. (f) Research involves specific critical assumptions. (g) Research requires the collection and interpretation of data to address the problems that initiated the research. (h) Research is naturally cyclical.
- 3) The research objectives commonly used to limit research problems are as follows: Exploration;

### Contribution of Philosophy of Science to Scientific Research

After briefly explaining the understanding of scientific research, several points about the contribution of the philosophy of science to scientific research can be outlined as follows:

#### 1. As the Foundation for the Development of Knowledge or Theory

The philosophy of science serves as a means of testing the reasoning of scientific theories. Critical principles towards scientific activities can enable a researcher to have a critical attitude towards their own field of knowledge, avoiding solipsistic attitudes, believing that only their opinion is correct. The philosophy of science is capable of testing, reflecting, and critiquing assumptions and scientific methods in a scientific research. Therefore, such an attitude can give rise to a new scientific theory and open possibilities for new discoveries in scientific research because research is a process to obtain answers to a question or problem. In science, patterns are always found, and then there is comfort with those patterns. In this context, science needs philosophy. Through the philosophy of science, these patterns are stimulated to discover the possibility of emerging new knowledge or theories. For example, in the study of positive laws, there is always disturbance as Critical Legal Studies. There is always another dimension in legal science that needs to be reconsidered and rethought. The Development of New Theories/Science, the content of a science is theory, so the development of science is a theory. There are several possibilities in theory development. First, formulating a new theory. Second, discovering a new theory to replace an old theory, meaning there is already a theory, but because it is considered no longer capable/relevant in solving a problem, it is replaced with a new theory. Third, revising an old theory. This means a researcher does not invalidate an old theory, nor does he replace it with a new theory; he only revises it, perfecting the old theory. Fourth, canceling an old theory. He only cancels it, does not replace it with a new theory. This is strange: he reduces the number of existing theories, cancels a theory, and does not replace it with a new theory, but it is still considered the development of science [17]; As the basis in academic study at the university level, the philosophy of science will provide an understanding of various basic assumptions in science and an understanding of the strengths and weaknesses of each scientific method so that, in due course, appropriate considerations can be made when conducting research. This is expressed by Sudarmita [18]. Even at the doctoral level of epistemology and the philosophy of science, it will be very helpful in generating a new scientific theory.

#### 2. Philosophy of Science Provides a Logical Basis for Research Methodology

The philosophy of science provides a logical foundation for research methodology. A scientific research method must be logically and rationally justifiable. Therefore, the contribution of the philosophy of science to research methods can provide a logical and systematic foundation.

Methodology is the science or branch of philosophy that discusses the ways to acquire knowledge. Methodology is included in the field referred to as "tool studies" or the science about "tools," meaning it is a science that functions as a "tool" for other sciences. On the other hand, the science that deals with materials, content, or the subject matter is called "content studies." Content studies are subjects that teach facts, materials, or information about a specific subject or course.

Methodology (including language and logic) is a tool subject required by all fields of knowledge. Regarding methodology and logic, both are two branches of philosophy that are closely related; therefore, sometimes, methodology is included in the study of logic. Logic discusses how to draw valid conclusions.

In the world of science, there are two dominant models of reasoning (logic), namely: inductive and deductive. Inductive reasoning involves drawing conclusions based on a set of data (sample); we draw conclusions (generalizations) about all facts that share a common theme in thought. Deductive reasoning, on the other hand, starts from general principles and draws more specific conclusions. Induction and deduction are processes of reasoning, or rules for drawing conclusions. Methodology is the science that discusses various methods used to discover theories or conclusions in various fields of knowledge (natural sciences, biology, sociology, psychology, politics, history, literature, etc.). Methodology discusses general aspects (observation, hypothesis, law, theory, experimental steps), but it can also address more specific aspects. For example, discussions on the fundamental ideas, assumptions, and application of phenomenological methods in sociology, as done by Alfred Schultz, or the fundamental ideas and application of interpretive methods in interpretive sociology by Peter Berger.

The contribution of the philosophy of science to research methodology can also be about filling and expanding the cognitive (intellectual) horizon about what is called science, which is expected to generate understanding for the discipline in scientific work and, at the same time, increase a researcher's motivation to carry out tasks earnestly. (Philosophy of science in scientific method). (The role of the philosophy of science) According to Beerling [19], the philosophy of science is an investigation into the characteristics of scientific knowledge and methods to acquire knowledge.

Therefore, the philosophy of science is closely related to epistemology, which generally investigates the conditions and forms of human experience, as well as logic and methodology. Thus, epistemology is an

evaluative, normative, and critical discipline. Evaluative means assessing whether a belief, attitude, question, opinion, or knowledge theory can be justified, guaranteed its truth, or has a rationally accountable basis. Normative means establishing norms or benchmarks, in this case, benchmarks for the truth of knowledge. Epistemology, as a branch of philosophy, not only provides a description or exposition of how the process of human knowing occurs but also needs to make determinations about what is correct and what is incorrect based on epistemic norms. Critical means questioning and testing the rationality of both the methods and results of human knowing activities. What is questioned includes assumptions, working methods or approaches taken, and conclusions drawn in various human cognitive activities [16].

### **Contribution of Philosophy of Science to Social Life**

In general, the philosophy of science has been able to advance scientific knowledge, and scientific knowledge has been able to propel technology forward. Technology serves as a means for both individuals and society to fulfill their needs. The development of science and technology can encourage humans to utilize natural resources more effectively and efficiently. The progress in science and technology can enhance the quality of human social life by increasing their skills and intelligence.

The discussion of the Philosophy of Science and Epistemology will also provide in-depth information about the history of the development of science and even technology. This will give historical awareness and strategic considerations in observing the development of the times. It enables individuals to understand the epistemological worldviews (assumptions) present in every episteme and culture. Science and technology become dominant elements as they serve as driving forces for the future of the world.

The philosophy of science can also contribute as an educational consideration. It helps students understand various forms of knowledge and comprehend their strengths and limitations, leading to a more holistic understanding. Practically, epistemology can provide an understanding of how to design life skill curricula that assist in dealing with real-life situations, where knowledge plays a role in solving various problems in general life or in religious life.

The contribution of the philosophy of science to the development of science and technology, quoting the opinion from Tafsir [17] on the contribution of science, is as follows: (1) Science as an Explanatory Tool. The development of science until now generally serves as a tool for explaining reality. According to Jacob [20], science is the most reliable explanatory system in its ability to explain and understand what happened in the past, present, and future. How does it work? At the end of 1997, there was a monetary turmoil in Indonesia, where the value of the rupiah became cheaper compared to the dollar (rupiah exchange rate against the dollar decreased). This phenomenon has had a significant impact on life in Indonesia. The symptom is that prices are getting higher. How can we explain this symptom?

Economic theories (possibly also political) can explain (explanate) this phenomenon. For simplicity, economic theory states that because of the many matured foreign debts (that need to be paid), the debt must be paid in dollars. Since many people need dollars and are buying dollars, the price of the dollar rises in rupiah. Well, this is only a part of the phenomenon that is explained. Even though it's only a part, the phenomenon has been understood to some extent, in accordance with what has been explained.

## **4. SUGGESTION**

The philosophy of science is necessary amid the development of science and technology marked by the increasing sharpening of scientific specialization. By studying the philosophy of science, scientists become aware of their limitations and avoid falling into an attitude of intellectual arrogance. What is more needed is an open-minded attitude among scientists, enabling them to greet each other and direct all their intellectual potentials for the benefit of humanity.

From the previous discussions, we can conclude the following points: The contribution of the philosophy of science to scientific research is as follows: Foundation for the Development of Science or Theory: The philosophy of science serves as a tool for testing the reasoning of scientific theories. It enables the testing, reflection, and criticism of assumptions and scientific methods in research. Basis in Higher Education: In higher education, the philosophy of science provides understanding of a) the basic assumptions in science and b) the strengths and weaknesses of each scientific method. This understanding allows for informed considerations when conducting research. Additionally, at the doctoral level, epistemology and the philosophy of science significantly contribute to the creation of new scientific theories.

In general, the philosophy of science has been successful in advancing scientific knowledge, and scientific knowledge, in turn, has propelled technological advancements. Technology serves as a tool used by individuals and society to fulfill their needs. Moreover, the philosophy of science can contribute as an educational consideration. It aids students in understanding various forms of knowledge, acknowledging their strengths and limitations, thereby fostering a more holistic understanding. Practically, epistemology provides insights into designing life skill curricula that can assist in addressing real-life problems, whether in general life or within religious contexts.

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