



Contribution of Philosophy of Science in Scientific Research: An Epistemological and Methodological Review

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ABSTRACT

Scientific research requires not only systematic empirical techniques but also a robust theoretical and philosophical foundation to ensure methodological rigor and validity. This study examines the historical and functional contributions of the philosophy of science to modern research methodology and paradigms across four distinct eras: Classical, Renaissance, Modern, and Contemporary. Utilizing a qualitative library research design combined with content analysis and historical-hermeneutic interpretation, this paper evaluates how evolving philosophical frameworks shape scientific inquiry. The findings demonstrate that philosophy provides the fundamental ontological, epistemological, and axiological pillars that govern research designs, transitioning scientific practice from medieval dogmatism to empirical observation, logical positivism, and ultimately contemporary pluralism. Furthermore, the study illustrates how philosophical reflection directly informs modern methodologies—such as big data analytics, artificial intelligence ethics, and interdisciplinary collaboration—by fostering critical reflectivity, operational transparency, and ethical accountability. By bridging historical philosophical developments with contemporary socio-technological practices, this research offers a comprehensive framework for embedding epistemological flexibility into modern research governance and scientific education.

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INTRODUCTION

Scientific research represents one of the most fundamental pillars driving human civilization, technological advancement, and academic progression. Through structured inquiries, empirical observations, and analytical interpretations, scientific activities aim to discover new truths, refine existing paradigms, and offer sustainable solutions to complex practical and theoretical problems. In higher education and professional research institutions, scientific inquiry is not merely a technical requirement or a mechanical routine; it is a systematic intellectual

endeavor governed by rigorous methodological standards and theoretical frameworks. However, in contemporary academic discourse, a concerning trend has emerged where scientific research is increasingly treated as a purely administrative or procedural exercise. Researchers often focus excessively on empirical quantitative tools, statistical software, and formal standardized templates while overlooking the fundamental conceptual foundations that validate their scientific claims. When research methodology is disconnected from its philosophical roots, the resulting knowledge risks becoming superficial, rigid, and lacking in critical depth.

This critical limitation highlights the indispensable role of the philosophy of science in scientific research. The philosophy of science serves as the foundational discipline that investigates the theoretical, methodological, and ethical premises of knowledge creation. It provides the essential analytical tools needed to examine how scientific inquiries are conceived, executed, and justified. Specifically, the philosophical inquiry operates through three fundamental pillars: ontology, epistemology, and axiology. Epistemology, in particular, addresses the nature, scope, limits, and validity of human knowledge. It interrogates how researchers come to know what they claim to know, what constitutes legitimate scientific evidence, and how theoretical propositions can be justified against empirical reality. On the other hand, methodology acts as the practical and logical bridge connecting epistemological assumptions with concrete research procedures. Without a clear epistemological awareness, research methods devolve into mere technical mechanics devoid of critical reflectivity, leaving researchers unable to defend the logical consistency and underlying assumptions of their chosen designs.

Throughout history, the evolution of scientific research has been intrinsically intertwined with major philosophical paradigm shifts. From Ancient Greece, where rationalism and natural philosophy laid the groundwork for logical reasoning, to the Renaissance period, which shifted human thought away from medieval dogmatism toward humanism, empirical observation, and experimentation. The modern era further solidified scientific inquiry through positivism, emphasizing objective measurement, testability, and universal natural laws. In the contemporary era, however, the understanding of science has undergone another profound transformation. Scholars such as Karl Popper, Thomas Kuhn, Imre Lakatos, and Paul Feyerabend introduced critical perspectives that challenged strict positivism. Concepts such as falsification, scientific revolutions, research programs, and methodological pluralism demonstrated that scientific progress is not a linear accumulation of absolute facts, but a dynamic, context-dependent, and historically situated process. Contemporary scientific research increasingly demands an open mindset that embraces interdisciplinary collaboration, the plurality of truths, and a reflective criticism of scientific arrogance.

Despite the vital role that philosophy plays in shaping scientific paradigms, existing literature often treats philosophy of science and practical research methodology as separate, isolated domains. Recent studies have addressed certain aspects of this relationship; for instance, Lubis et al. (2024) discussed the role of the philosophy of science in educational approaches, focusing primarily on instructional contexts. Saputro et al. (2024) explored the general relationship between philosophy and knowledge in the digital era, while Subekti et al. (2021) examined the

broader social impacts of philosophical thinking on scientific inquiry. Furthermore, studies by Santi et al. (2022) and Azfirmawarman et al. (2023) underscored the importance of philosophical values in maintaining research objectivity and scientific integrity. However, a significant research gap remains in the current body of literature. Most existing works either offer overly abstract theoretical overviews of philosophy or focus narrowly on historical chronologies without systematically synthesizing how historical philosophical shifts specifically translate into concrete epistemological standards and methodological choices in modern scientific research. There is a noticeable absence of a structured review that explicitly connects epistemological justifications with practical research design across qualitative, quantitative, and interdisciplinary domains.

To bridge this literature gap, this article provides a comprehensive epistemological and methodological review of the contribution of the philosophy of science to modern scientific research. By systematically analyzing the transition of philosophical paradigms from classical antiquity to contemporary post-positivist frameworks, this study highlights how epistemological assumptions directly shape research questions, data collection techniques, validation criteria, and analytical interpretation. Furthermore, this review examines how integrating philosophical reflectivity enhances researchers' critical capacity, allowing them to navigate complex multidimensional problems, maintain ethical integrity, and avoid dogmatism in an increasingly complex digital age.

The primary objective of this article is threefold: first, to trace the historical and paradigm shifts in the philosophy of science and their direct impact on scientific inquiry; second, to evaluate the core epistemological and methodological contributions of philosophy to research design; and third, to propose an integrated conceptual framework that reconnects philosophical principles with modern research practices. By addressing these objectives, this study aims to contribute significantly to the literature on research methodology, providing graduate students, academics, and researchers with a deeper, more reflective understanding of the scientific process. Ultimately, this review demonstrates that philosophy is not an outdated, abstract discipline, but a living, practical necessity that safeguards scientific rigor and drives meaningful academic innovation.

METHOD

This study employs a qualitative approach using the library research method to systematically analyze, evaluate, and synthesize the epistemological and methodological contributions of the philosophy of science to scientific research. Library research was selected because the primary focus of this study involves conceptual analysis, historical paradigms, and theoretical frameworks derived from authoritative scholarly literature.

The data collection process was conducted through a structured documentary search across reputable academic databases, including Google Scholar, Scopus, and Sinta-indexed portals. The literature selection was guided by specific inclusion criteria: (1) primary and secondary texts on the history and philosophy of science (spanning classical Greek, Renaissance, modern positivism, and contemporary paradigms); (2) peer-reviewed journal articles and reference books addressing research methodology and scientific epistemologies; and (3) recent publications (primarily from 2018–2024) discussing the contemporary role of philosophy in scientific inquiry.

To process and evaluate the retrieved textual data, this study applied qualitative content analysis (*analytical content analysis*) alongside conceptual analysis. The data analysis proceeded through four distinct stages: Data Identification and Categorization; Classifying literature based on thematic focus (e.g., historical evolution, epistemological foundations, and methodological frameworks), Data Reduction; Filtering out redundant or non-essential information to isolate core arguments regarding ontological, epistemological, and axiological concepts, Conceptual Mapping; Synthesizing the relationship between philosophical paradigm shifts (such as Popper's falsification, Kuhn's paradigms, and Feyerabend's pluralism) and their concrete impacts on modern research designs, Interpretation and Conclusion Drawing; Critically discussing the implications of philosophical reflectivity for research integrity, interdisciplinary collaboration, and modern scientific methodology.

To ensure conceptual validity and rigor, source triangulation was maintained by cross-referencing classical philosophical texts (e.g., Feyerabend, Kuhn, Bertens) with contemporary empirical studies on research methodologies (e.g., Subekti et al., 2021; Saputro et al., 2024; Lubis et al., 2024).

FINDINGS AND DISCUSSION

Philosophy of Science and Scientific Research

A. Cornelius Benjamin argues that "philosophy of science" is a subfield of "philosophy" that seeks to provide a systematic framework for understanding and applying scientific principles, techniques, and ideas within the broader "general" disciplines. Lewis White Beck also argues that the examination and evaluation of the processes of knowledge formation and the attempt to understand the significance of knowledge as a whole are the foundations of science. In the same vein, Michael V. Berry explains that the philosophy of science is the study of the focus of Islamic methodology on the relationship between theory and practice, and the interrelated logic of many Islamic beliefs, which are the foundation of science. Meanwhile, May Brodbeck argues that the presentation and explanation of fundamental ideas, supported by universal analysis and in ethics and philosophy, are the foundations of scientific inquiry (Umar, 2018).

Applied philosophy focuses on scientific questions and attempts to find solutions. The foundations of science aim to provide a thorough, analytical, and systematic explanation of knowledge, which is the source of enlightenment. Studying the philosophy of science aims to gain a clear, precise, and comprehensive understanding of science, so that we can recognize the scientific method and its main components. This will enable us to identify the basic framework and important attributes of true science (Ernita, 2019).

While scientific research is a systematic process carried out to obtain new knowledge or confirm existing knowledge through observation, experimentation, and data analysis. This process involves structured steps, such as identifying problems, formulating hypotheses, collecting data through scientific methods, and testing the results to draw conclusions that can be accounted for. The purpose of scientific research is to produce objective, retestable knowledge that contributes to the development of science and its application in solving practical problems.

The basis of academic study is a systematic body of knowledge that, when applied to previously studied events, provides a consistent and acceptable explanation for human religion. The goal of Islamic scientific research is to advance new information to a level of applicable knowledge. Scientific arguments rely on this kind of evidence, which is used to test hypotheses, determine cause-and-effect relationships, and more. Research is defined as an organized effort to find answers to questions using scientific procedures. Research, often referred to as study, is an academic activity aimed at learning more about a topic or issue. The information gathered can take several forms, including facts, theories, conceptions, and generalizations. All scientific investigations must adhere to established methodological norms and underlying assumptions. Researchers need not only expertise but also good character traits, including a dedication to the pursuit of truth, objectivity, and a strong understanding of moral ideas. There are specific protocols that researchers must adhere to when collecting data. The methods individuals use to study their own goodness in all its aspects are the subject of methodological discussions.

Researchers use research methodology to collect data with clear goals and objectives. Some aspects of the scientific method :

- a) Reasonable, meaning that the research is conducted in a reasonable manner;
- b) Based on empirical evidence, meaning that the validity of the procedure can be proven; and
- c) Systematic, meaning that the investigation is conducted with rational and logical procedures (Ali, 2022).
- d) To achieve their goals, researchers rely on research methods to collect relevant data (Siroj et al., 2024).
- e)

History and Development of Philosophy of Science: Introduction

- a) Ancient Greek philosophy of science

Ancient Greek philosophy flourished from the sixth century BCE to the sixth century CE. Any information or understanding that was not based on reason and could not be explained by human reason was viewed with skepticism by Greek culture, as was any information or understanding that was concerned with finding answers to questions. During the reign of Alexander the Great, Ancient Greece emerged from 356–323 BCE, marking the beginning of the Hellenistic era. Unlike societies in other parts of the world, Greek culture was not built on caste, priesthood, or religious dogma. Their general intelligence increased as a result. Knowledge of the sea, including its origins and evolution, was a major goal of philosophy during this period, as noted by previous authors in this debate. Both the planet and its inhabitants underwent philosophical metamorphoses throughout history. Even after accepting and loving humans, Greek culture maintained its cosmic perspective.

As the Golden Age ended, philosophers noted a number of shifts that had occurred during the period. The philosophy of nature did not satisfy philosophers, which is why it contributed to the decline of human philosophy. Natural philosophy, in their view, failed to adequately explain human nature. Philosophers such as Socrates, Plato, and Aristotle were prominent throughout

this period. To know oneself is the most valuable knowledge, Socrates said. Concepts that emerge from empirical study, Plato believed, constitute reality. Human philosophy had lost favor because natural philosophy failed to satisfy its adherents. Natural philosophy, in their view, failed to offer a comprehensive analysis of human nature. Philosophers such as Socrates, Plato, and Aristotle were prominent throughout this period. To know oneself is the most valuable knowledge, Socrates said. Ideas supported by evidence have inherent actuality, Plato believed (Tanjung, 2022a).

b) Renaissance philosophy of science

The Renaissance in the philosophy of science, which lasted from approximately the 14th to the 17th century, was an important transitional period in the development of scientific and philosophical thought in Europe. It was a time of great shift from medieval thought, which was dominated by religious dogma, to a more rational, observational and experimental approach. The philosophy of science during the Renaissance was driven by a revival of classical Greek and Roman studies, and an emphasis on humanism and a freer and more open pursuit of knowledge. Important figures such as Nicolaus Copernicus, Galileo Galilei, and Johannes Kepler influenced views of the universe with theories that contradicted the traditional views of Ptolemy and the Church (Bertens, 1976). The root of the word "renaissance" comes from the Persian language, meaning a reconnection with antiquity. This history is the only basis that participants use to refer to the phrase as a period of intellectual rebirth.

During this era, there was a major change in the way European society thought during the Renaissance, namely the shift from thinking dominated by religious dogma to more humanistic and rational thinking. During the Middle Ages, many aspects of life, including science, art, and philosophy, were influenced or even controlled by religious teachings, especially by the Catholic Church. This religious dogma often directed people's perspective on the world and the universe, and limited critical thinking that was secular or non-religious. At the same time, this period saw a revival of interest in classical Greek and Roman thought that prioritized reason, intellectual freedom, and the development of human potential. Humanism, as the main school of thought at that time, emphasized the importance of human abilities and values as rational, creative individuals with the potential to develop. Focusing on humans and their life experiences, humanism invited people to explore the world in a more critical way, free from dependence on religious dogma.

Religious dogma was replaced by humanism during the Renaissance. The Humanist Era, sometimes called the Age of Man, is characterized by its roots in the Middle Ages. Humanism held that every person is valuable because of their rationality. That each person has the power to create their own reality and identity is at the heart of humanism. The humanist stance that rejected Christianity was increasingly marginalized as secular scientific knowledge and rational thought became increasingly separated from spiritual and religious principles. During the Renaissance, it impacted many other fields of study (Hardiman, 2004). Anyone who believed in humanism at the time could hone their skills and have fun. The Renaissance brought many changes, including a new skepticism, innovative ideas, increased trade and scientific understanding between Europe

and Latin America, new schools of scientific thought, and a stronger sense of national unity throughout Europe (Tanjung, 2022).

c) Philosophy of science in the modern era

The era of positivism played a significant role in scientific progress, where positivism focused on the evaluation of knowledge and research methodology that could be measured and tested objectively. Among the many members of the 20th-century positivists were Gustav Bergman, Rudolf Carnap, Philip Frank Hans Hahn, and many more. Positivism, pioneered by Auguste Comte, emphasized that only knowledge that can be proven through observation and experimentation is legitimate and valid. This approach encouraged the development of science by emphasizing the importance of empirical data and natural laws that can be understood rationally and systematically. As a representation of the history of the development of modern philosophy, positivism also contributed to a paradigm shift in the way of scientific thinking, replacing speculative approaches with more structured and evidence-based methods. This philosophy then gave birth to various new schools of thought and thoughts in the social and natural sciences, leading to the development of stronger and more accepted scientific methods in various disciplines. For example, the development of Logical Empiricism, a positivist-logistic school of thought that built the basis for scientific knowledge at the turn of the twentieth century. This school was founded and developed by the Vienna Circle.

Pragmatic empiricism is strongly opposed by rationalists, also called radical empiricists. There is no perfect guarantee in radical empiricism. When viewed through the lens of experiential understanding, every event is the sum of all the impressions that people bring to bear on the world through their encounters with physical objects, ideas, and feelings. What cannot be explained within such a framework is perceived as a set of beliefs. That is why this extreme empiricism is sometimes called the rejection of objectivism (Subekti et al., 2021).

d) Philosophy Of Science in The Contemporary Era

Contemporary philosophy of science refers to the development of philosophical thought that has occurred since the 20th century until now, where there has been a major shift in the way of viewing science, methodology, and the goals of scientific research. Thought in contemporary philosophy of science is greatly influenced by the development of science itself, social change, and increasingly rapid technological progress.

One of the main characteristics of this thinking is a shift in focus to methodology and epistemology, with philosophers such as Karl Popper, Thomas Kuhn, and Imre Lakatos proposing new theories about how science develops, with Popper emphasizing falsification as a way to distinguish valid scientific theories, Kuhn introducing the concept of scientific revolutions through paradigm shifts (Putri & Iskandar, 2020), and Lakatos emphasizing flexibility in scientific research programs. In addition, contemporary philosophy of science has also increasingly moved towards relativism, with the view that there is no single objective truth that applies in all situations, as exemplified by philosophers such as Feyerabend who emphasized the plurality of scientific methods. At the same time, he criticized the intellectual arrogance that claimed an objectivity of science (Feyerabend, 2020). This era also emphasized the importance

of interdisciplinary approaches, where different branches of science collaborate to understand complex phenomena, and paid more attention to the relationship between science and society, as exemplified in the discourse on scientific ethics concerning the impact of technology on human life. Philosophers such as Habermas and Latour have called for consideration of the social, political, and cultural contexts in which scientific knowledge develops, highlighting how social values and non-human actors influence scientific knowledge. Overall, contemporary philosophy of science seeks to understand and respond to the epistemological, ethical, and social challenges faced by modern science, and to explore its role in advancing an increasingly complex human civilization.

The main characteristics of the philosophy of science in the contemporary era are the acceptance of the plurality of truths and the rejection of the cult or affirmation of a single truth that is general or universal. In the contemporary philosophy of science, thinkers such as Paul Feyerabend and Thomas Kuhn emphasize that science cannot be limited by one method or one single view that is considered absolute truth (Bertens, 2014b). They argue that science develops in a dynamic context and often through changes in paradigms or different approaches.

The plurality of truths refers to the recognition that truth is not just one, but can vary depending on the context, perspective, and approach used. For example, in the social sciences and humanities, truth is often seen from many perspectives, reflecting the diversity of human experience and interpretation of the world. Therefore, the contemporary philosophy of science rejects the cult of one truth or theory that claims to be absolutely true and applies to everything. This is also related to the idea that science and knowledge develop through dialogue, criticism, and continuous revision. In other words, in the contemporary philosophy of science, scientists do not only seek one universal truth (Bertens, 2014a), but are more open to various views and methods that can provide a deeper and broader understanding of the world. This thinking reflects a more inclusive and flexible attitude towards how we view truth in science.

Contribution of philosophy of science in Scientific Research

In academic activities, scientific research is not a foreign thing for educators and students. It is included in the academic category, those who are called academics cannot possibly not carry out research activities. Simply put, scientific research is a systematic process of obtaining, analyzing, and concluding information or data to answer certain questions, solve problems, or develop new knowledge. This process is carried out based on the scientific method, which involves structured steps such as observation, hypothesis formulation, experimentation, data analysis, and interpretation of results. Scientific activities aim to produce objective, valid, and retestable knowledge. This activity is usually carried out by adhering to basic principles such as objectivity, transparency, rationality, and openness to criticism and revision (Sukmawati et al., 2023). Scientific research is as old as the development of science itself.

Scientific research as a systematic approach to knowledge began to develop significantly since the Renaissance era (14th to 17th centuries). During this period, thinkers began to abandon traditional dogmas and began to prioritize empirical observation and experimentation as a way to

understand the world. Of course, this shift is inevitable. This is because science that changes itself will have an impact on the design of scientific research (Maghfiroh et al., 2023). This transformation continues to this day, showing that science is a dynamic entity that always evolves to answer the challenges of the times.

This shift is not only inevitable, but also the basis for the development of new approaches to understanding natural and social phenomena. Science, which was once bound by religious authority and tradition, began to move towards intellectual freedom that allows humans to question, observe, and test the truth independently. This paradigm shift has a direct impact on the design of scientific research. One significant impact is the emergence of a structured scientific method, which includes observation, hypothesis formulation, experimentation, data analysis, and drawing conclusions. Research design no longer relies solely on speculation or assumptions, but also on empirical evidence that can be retested (Muslim et al., 2023). This creates new standards in science, namely objectivity, validity, and reliability.

The philosophy of science plays an important role in research methods and scientific mentality. This basis is believed to be able to instill discipline in the process of developing scientific work, while encouraging researchers to give their best efforts in their research. According to Beerling, the main purpose of scientific research is to present evidence regarding the nature and level of human understanding. In addition, some research procedures are based on logical principles that can be explained through the philosophy of science (Muslim et al., 2023).

Philosophy of science enables us to critically evaluate scientific endeavors by providing a framework for evaluating scientific reasoning. To distinguish ourselves from our solipsistic peers who assume that only the most important findings matter, scientists need to be able to think critically about our own field of study. Philosophy of science is an academic discipline that involves thinking critically about, evaluating, and critiquing scientific beliefs. Researchers today face the difficult task of trying to implement a particular learning strategy while ignoring the underlying information structure. Learning methods that are consistent with or compatible with the structure of knowledge are needed here, not the other way around. Rather than being representations of knowledge, methods are simply ways of thinking (Azfirmawarman et al., 2023).

In the development of science, academic activities are required to be objective. This is because research activities are required to be objective, systematic, and transparent so that the results obtained have high validity and credibility. However, subjective elements from researchers cannot be avoided in academic activities. Objectivity in research means that researchers must free themselves from personal bias, prejudice, or certain interests that can affect the research process and results. A systematic approach ensures that every step in the research, from problem identification to data analysis and drawing conclusions, is carried out in a structured manner and in accordance with established methodologies. In addition, transparency is also an important aspect, where researchers must explain in detail the process, methods, and research findings so that they can be checked and retested by the scientific community (Santi et al., 2022). The combination of objectivity, systematicity, and transparency is the main foundation in maintaining scientific integrity and ensuring that research contributes to the development of knowledge that is

reliable and beneficial to society. In addition, this shift also encourages diversification of research approaches. New fields such as astronomy, physics, chemistry, and biology are experiencing a surge in development, supported by more specific and targeted research designs. Even in the realm of social sciences, empirical approaches have begun to be applied to understand human behavior and social dynamics, which were previously considered difficult to measure scientifically (Lestari et al., 2022). This diversification of research approaches has not only broadened the scope of science but also improved the quality and relevance of research results. In the natural sciences, experimental methods and systematic observations are the basis for discovering universal laws that govern natural phenomena. Meanwhile, in the field of social sciences, quantitative and qualitative approaches have been developed to capture the complexity of human behavior and social interactions in greater depth.

The consequence of this development is the creation of specialization in various fields of science. Researchers have begun to focus on certain fields, allowing for faster and more focused progress. However, this diversification has also raised challenges, such as the need for collaboration between fields to answer complex questions that cannot be solved by one discipline alone. Therefore, integration between various approaches and disciplines is becoming increasingly important in facing multidimensional global challenges.

In the modern era, technological developments and interdisciplinary approaches have provided significant impetus to the transformation of scientific research design (Winata, 2014). Researchers now have access to advanced technologies such as big data, artificial intelligence, and computer simulations, which allow for the analysis and modeling of phenomena that are much more complex than before. For example, big data allows researchers to process and analyze millions of data points in a short period of time, providing deep insights into trends and patterns that are not visible through conventional methods. Although research methodologies and tools continue to evolve, the basic principles formulated during the Renaissance remain the foundation. The belief that scientific truth must be based on verifiable empirical evidence and rational logic continues to be the cornerstone of scientific research. This principle ensures that even as approaches and technologies change, scientific integrity remains intact, ensuring that research results make a real contribution to science and humanity. Thus, the paradigm shift in science during the Renaissance and up to the present day has not only changed the way humans think, but also reshaped how scientific research is designed and conducted. This paradigm shift has created a new era in which scientific research no longer serves merely as a tool for understanding natural phenomena, but also as a major force in shaping human civilization. In the modern era, scientific research has become a central pillar in the development of technology, medical innovation, and solutions to global challenges such as climate change, food security, and public health. Increasingly complex and interdisciplinary research designs have enabled scientists to answer questions that were previously unattainable. This new paradigm also emphasizes the importance of international collaboration, where science across borders works together to find universal solutions. By adhering to basic principles such as objectivity, rationality, and openness to

verification, scientific research continues to grow as a key foundation for building a better and more sustainable future.

CONCLUSION

Philosophy has undergone significant changes and shifts throughout its history, reflecting the dynamics of how humans understand the world and themselves. From the classical era that focused on metaphysics and ethics, to the modern era that emphasizes rationalism and empiricism, philosophy continues to adapt to the context of the times. Meanwhile, scientific research itself cannot be separated from science, because the two are interrelated in efforts to understand, explain, and utilize natural and social phenomena.

Philosophy has made fundamental contributions to scientific research by providing theoretical, methodological, and ethical foundations that ensure the integrity and relevance of science in human life. Since the Renaissance, a paradigm shift in the philosophy of science has encouraged scientific research to develop from traditional exploration to a more systematic, empirical, and directed approach. Principles such as objectivity, rationality, and verification, which are the legacy of philosophy, become the main framework in scientific activity.

In the modern era, with the development of technology and the emergence of interdisciplinary approaches, the philosophy of science remains relevant as a guide in facing new challenges. Philosophical concepts, such as the plurality of truth and the rejection of the cult of generalization, provide flexibility in designing research that is able to answer complex questions across disciplines. Through the integration of philosophical values, scientific research becomes not only a tool for gaining knowledge, but also an instrument for building a better and more sustainable society. Thus, philosophy continues to play a vital role in keeping scientific research on track, ensuring that every step taken by the scientific community is based on a solid logical and moral framework, and makes a real contribution to the development of human civilization.

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