



Epistemology of Science in Scientific Research

Nur Afika Fitriani^{1*}, Yaumi Rohmah², Agung Winarno³

¹⁻³ Faculty of Economics and Business, Universitas Negeri Malang, Indonesia

Email: nur.afika.2404138@students.um.ac.id^{1*}, yaumi.rohmah.2404138@students.um.ac.id²,
agung.winarno.fe@um.ac.id³

*Corresponding author: nur.afika.2404138@students.um.ac.id

Abstract: Epistemology is a branch of philosophy known as the epistemology of science that focuses on basic questions about scientific knowledge, such as how knowledge is acquired, developed, and validated. The methods used in idea articles are useful for developing new ideas, critiquing existing theories, or providing new insights into the issues or problems being discussed. There are several reasons why people should study epistemology: first, strategic reasons because strategy is fundamental to achieving certain goals. Second, cultural reasons, because culture is part of knowledge and is important in every aspect of culture. Third, educational reasons, because education is a conscious effort to develop views of life, attitudes, and perspectives.

Keywords: epistemology, philosophy, education.

1. BACKGROUND

Epistemology of science is a branch of philosophy that focuses on the study of knowledge, how it is acquired, and how we can ensure that the knowledge generated through the scientific method is valid and valid. In scientific research, an epistemology of science is critical because it serves as a theoretical foundation for scientists to understand and evaluate how they acquire, organize, and interpret information. Scientific research itself, which leads to discoveries and solutions to various problems, cannot be separated from the epistemological understanding of how scientific truth can be achieved and tested (Tarigan & Alfansyah, 2023).

The importance of epistemology in science lies in the fact that the scientific method—which includes observation, experimentation, data collection, analysis, and hypothesis testing—is inseparable from deep questions about the validity and credibility of the knowledge it produces. Without a clear epistemological understanding, scientific research can become mired in methodological errors, biases, or unjustified claims. Therefore, the epistemology of science provides a framework that allows scientists to define what they consider to be valid scientific knowledge and how that knowledge can be tested and accepted by the scientific community.

In scientific research, epistemology plays a role in several aspects, such as the selection of methods used (e.g. experiments, observations, or case studies), the formulation of testable hypotheses, and the evaluation of existing theories. In addition, epistemology also helps researchers understand the limitations of scientific knowledge itself, both in terms of the

theories and methods used, as well as the challenges in ensuring the objectivity and replication of research results.

Thus, the epistemology of science focuses not only on how science operates to gain knowledge but also on how we understand the process and products of scientific knowledge in a broader context. A deep understanding of the epistemology of science is essential for researchers to ensure that the scientific process they undertake truly produces knowledge that is accountable, testable, and relevant in answering the big questions that exist in the scientific world.

Against the background outlined, we will explore various basic concepts of the epistemology of science that are relevant in the context of scientific research, as well as how the relationship between theory, method, and testing plays an important role in forming valid and reliable knowledge in the scientific world.

2. RESEARCH METHODS

The idea article research method is a useful approach to developing new ideas, critiquing existing theories, or providing new insights into issues or problems being discussed. Although it does not involve empirical data collection, this method still makes a major contribution to the academic and intellectual world by providing a theoretical basis or idea that can be used as a reference for further research. The success of idea article research lies in the depth of literature analysis and the researcher's ability to develop original and relevant ideas. (Slamet, 2016).

3. DISCUSSION

Epistemology of science is a branch of philosophy that focuses on fundamental questions about scientific knowledge, namely how it is acquired, developed, and validated. In the context of scientific research, an epistemology of science plays a central role because it underlies how scientists collect data, formulate hypotheses, test theories, and build more general knowledge. Scientific knowledge involves not only observation and experimentation but also requires deep reflection on how that knowledge can be trusted, tested, and accepted by the scientific community.

a. The Basic Thoughts of Epistemology of Science

Epistemology of science seeks to clarify and define what is meant by "scientific knowledge" and how the scientific process can be relied upon to obtain valid knowledge. Epistemology of science suggests that scientific knowledge is open to

testing, replicable, and dynamic, that is, always ready to be revised or improved in the light of new evidence. Thus, an epistemology of science provides an important theoretical foundation for scientific research.(Maksum, 2018).

b. Scientific Method and Epistemology

The scientific method is a systematic way of collecting and analyzing data to produce scientific knowledge. In this process, the epistemology of science provides guidelines on how each step in the scientific method should be carried out to ensure that the knowledge obtained is valid and acceptable.(Munip, 2024).

Observations and Hypotheses: In the early stages, scientists ask questions based on initial observations of natural phenomena. Epistemology plays a role in determining how we view these phenomena and formulate testable hypotheses.

Experiments and Data Collection: In the experimental stage, scientists test their hypotheses by collecting empirical data. The epistemology of science asks about the validity of the data, and whether it truly reflects the existing reality or is influenced by observer bias.

Theory and Deductive Reasoning: Once data is collected, scientists will formulate a theory that can explain the phenomenon. This is where epistemology comes into play in assessing the strength of the theory: whether it can be tested, and retested, and whether it offers a broader explanation than just the specific phenomenon being tested.

Falsification and Verification: One of the important concepts in the epistemology of science is the principle of falsification proposed by philosopher Karl Popper. Popper argued that a valid scientific theory can be tested and proven wrong (falsifiable). The verification process is also important, namely the effort to confirm whether the results of experiments or observations are by the existing theory.

c. Epistemological Technique Theory in Scientific Research

According to Karimaliana et al (2023) Several epistemological theories have a major influence on scientific research:

a) Positivism

Positivism, pioneered by Auguste Comte and John Stuart Mill, emphasized that valid knowledge can only be obtained through empirical observation that can be tested and verified. Positivism has greatly influenced modern scientific approaches, especially in quantitative research, which emphasizes the use of statistical methods and experiments to produce objective and reliable data.

b) Empiricism

Empiricism, represented by figures such as David Hume and John Locke, argues that knowledge comes from sensory experience. In the context of scientific research, empiricism emphasizes the importance of direct observation and data collection through experiments or observations. Therefore, empirical epistemology supports the use of scientific methods that are based on testable data.

c) Rationalism

In contrast to empiricism, rationalism emphasizes that knowledge can be obtained through logical reasoning and deduction, independently of sensory experience. In scientific research, rationalism focuses more on developing theories that can be tested logically and conceptually, such as mathematical theories or physical models.

d) Pragmatism

Pragmatism, developed by philosophers such as William James and John Dewey, proposes that scientific knowledge is best measured by the extent to which theories are useful in solving practical problems. In scientific research, pragmatism directs researchers to seek solutions that can be implemented in the real world, while still taking into account existing theoretical principles.

e) Constructivism

Constructivism argues that knowledge is not only discovered through objective observation but also actively constructed by individuals or groups through social interaction and experience. In scientific research, constructivism encourages researchers to consider the social, cultural, and cognitive contexts in the process of seeking knowledge.

f) Falsification and Confirmation

The concept of falsification proposed by Karl Popper emphasizes that science develops through the process of testing and the possibility of proving a theory wrong. On the other hand, the confirmation method, which was more popularized by figures such as Imre Lakatos, emphasizes the importance of supporting evidence to strengthen the theory.

d. The Importance of Objectivity in Scientific Research

One of the main aspects of the epistemology of science is the achievement of objectivity. Objectivity in scientific research means that scientific findings are not influenced by the researcher's biases, personal assumptions, or subjective views. The

epistemology of science teaches that scientists should strive to maintain neutrality in data collection analysis, theory development. However, in practice, objectivity can be difficult to achieve completely, as factors such as observer bias, social and political influences, and cultural values can influence how scientists approach problems or interpret data. Nevertheless, efforts to avoid bias and ensure transparency in research methods are basic principles in the epistemology of science (Zaharuddin et al., 2021).

e. Scientific Paradigms and Paradigm Shifts

Thomas Kuhn in his book *The Structure of Scientific Revolutions* introduced the concept of a "scientific paradigm," which refers to a scientist's framework or way of viewing the scientific world at a given time. Kuhn points out that science does not always develop linearly, but often experiences paradigm shifts, a major change in the way scientists view the world that leads to a scientific revolution. These paradigm shifts occur when existing theories can no longer explain new phenomena or experimental results that are inconsistent with existing theories. For example, the revolution in physics sparked by Einstein's theory of relativity or quantum mechanics are clear examples of paradigm shifts in science (Rokhmah, 2021).

f. Challenges and Criticisms of the Epistemology of Science

According to Karimaliana et al (2023) epistemology of science provides a strong theoretical basis for scientific research, this approach also faces criticism, especially in terms of:

a) Relativism

Critics of the postmodern view argue that scientific knowledge is not entirely objective and cannot be separated from the wider social and cultural context. Therefore, scientific views are often considered relative, depending on the cultural background and ideology of the scientist.

b) Social Construction of Science

Some thinkers, such as Bruno Latour, argue that science is more the result of social consensus among the scientific community than an objective discovery of truths that exist in the world. This leads to the understanding that science is a social construction influenced by power, politics, and culture.

g. Epistemology as a Source of Knowledge

Knowledge about the nature of humans is studied by one branch of philosophy, namely epistemology. Epistemology is a branch of philosophy that studies the basis and limits of knowledge. As a scientific discipline, epistemology plays an important role in

becoming a foundation for the development of other sciences in its field (Fuadi et al., 2021). In discussing epistemology, three main aspects are the focus. First, the source of knowledge and the process used to obtain that knowledge. Second, the nature of knowledge itself, including how humans as individuals can understand it. Third, the truth of knowledge, which highlights the extent to which humans with all their limitations can understand and ensure that truth. Epistemology plays a role in determining the characteristics of knowledge, including the criteria for truth that can be accepted by humans or considered unacceptable. Knowledge that is stated to be true and systematically classified can be called part of epistemology (Mangunjaya, 2015).

Epistemology is a branch of material logic that discusses knowledge. In epistemology, experience has a more dominant role than the role of reason in gaining knowledge. However, the experience does not stand alone, because basically, the knowledge gained through experience involves an active process of the senses which is then processed and displayed by reason.

There are three main reasons why humans need to study epistemology. First, strategic reasons, where strategy is an important element in human life to achieve certain goals. Second, cultural reasons, because culture is part of knowledge, and knowledge has a significant role in every aspect of culture. Third, educational reasons, because education is a conscious effort to develop a view of life, attitudes, skills, and other aspects (Sulastriyani, 2023).

4. CONCLUSION

Epistemology is a branch of philosophy known as the epistemology of science that focuses on basic questions about scientific knowledge, such as how knowledge is acquired, developed, and validated. In epistemology, science provides an important theoretical foundation for scientific research because scientific knowledge is testable, replicable, and always changing according to new information. The systematic way to collect and analyze data to produce scientific knowledge is known as the scientific method. Epistemology of science provides guidelines on how each step of the scientific method should be carried out to ensure that the information produced is true and acceptable.

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