



Philosophy of Science as a Foundation for Scientific Method Development

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Article Info

Article history:

Received 17-11-2024

Revised 20-11-2024

Accepted 31-12-2024

Keywords:

Philosophy of Science
Developing
Scientific
Methods

ABSTRACT

Philosophy of science plays a critical role as the epistemological foundation in shaping research methodologies and guiding scientific inquiries. Although previous literature emphasizes the theoretical connection between philosophy and science, studies synthesizing how specific philosophical paradigms directly dictate operational research designs remain limited. This study aims to analyze the role of philosophy of science in developing scientific methods through a critical synthesis of ontological, epistemological, and axiological pillars across major research paradigms. Utilizing a descriptive-analytical library research approach, relevant literature on philosophy, methodology, and scientific inquiry was systematically examined. The findings demonstrate that philosophical paradigms directly govern research operations: (1) positivism enforces quantitative, experimental designs aimed at empirical verification and causal relationships; (2) constructivism drives qualitative, naturalistic approaches focused on contextual meaning and dialectical interpretation; and (3) pragmatism serves as the theoretical bridge for mixed-methods research, prioritizing practical problem-solving over methodological purity. Furthermore, the study underscores that integrating axiological reflection is vital for navigating contemporary methodological challenges, including algorithmic bias and data ethics. In conclusion, philosophy of science provides both the logical structure for operational methodology and the ethical framework necessary for maintaining scientific integrity.

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INTRODUCTION

Philosophy of science is a branch of philosophy that studies the foundations, concepts, and assumptions underlying the process of seeking knowledge. In the history of human civilization, the development of science has never been free from the influence of philosophy as a critical and systematic framework for thinking. Philosophy of science not only functions as a critical reflection on the nature of science, but also becomes the basis for the development of scientific methods. The

scientific method, as the main means in the development of science, did not just appear out of nowhere, but was born from the struggle of philosophical thought that aims to ensure that the process of discovering knowledge can be carried out rationally, objectively, and measurably. In terms of modern science and technology, the Greek dynasty is an incalculable minority (Kivunja & Kuyini, 2017).

The intellectual tradition is far ahead of its contemporaries. A person's complete thought process can be characterized as philosophical because of the complementary nature of philosophical reasoning and scientific inquiry. The intellectual transition symbolized from a superstitious worldview to a rational and evidence-based worldview has impacted people all over the world, not just the Greeks. On this basis, the focus shifted from *mitosis*, or empirical evidence, to *logosis*, or theoretical argument based on knowledge. Today, proficiency in various communication and IT tools is a must-have skill. However, these technologies can only be used in an academic setting if they produce something that can be tested (Schizas et al., 2016).

Scientific thinking is defined as introspection that produces structured concepts and the creation of verifiable truths based on the philosophical foundations of science. Knowledge is based on the capacity to use information in all areas of human life. Axiology, ontology, and epistemology form the scientific foundation, which is an essential part of knowledge-based scientific progress. The main reason for this is the important function of the foundation in expanding our understanding of scientific concepts. Rather than relying solely on facts, the relationship between facts and scientific methods forms the basis of knowledge (Achadah & Fadil, 2020).

In Islam, the basic purpose of education is to instill knowledge in accordance with Islamic law or values. As an idea, the scientific method is the “key” to scientific inquiry. The study of prayer (material endeavor) is relevant to any endeavor. Many ordinary items can be transformed into useful construction materials. There must be measurable and observable components to each and every aspect of the natural world studied. Future research approaches that align with the knowledge-based teaching approach can be built upon these investigations (Dwisusila et al., 2023). Repeated testing under identical conditions yields identical results; this cycle continues until the hypothesis is rejected, at which point scientific inquiry, a systematic type of research based on empirical evidence, begins. This is the process of acquiring scientific information. The results are visible to anyone who tries them.

In the modern context, the need to understand the philosophy of science is even more important because the rapid development of science is often accompanied by ethical, methodological, and epistemological challenges. The philosophy of science helps answer fundamental questions, such as what counts as scientific knowledge, how such knowledge can be verified, and what are the implications of using such knowledge in human life. Thus, the philosophy of science is not only a theoretical reflection, but also becomes the foundation for the development of scientific methods that can be used to solve real problems in various fields (Lestari et al., 2022).

In the midst of the complexity of science today, an understanding of the philosophy of science also provides guidance for scientists in maintaining scientific integrity, avoiding bias, and

ensuring that science is not only theoretically relevant, but also provides benefits to humanity. Therefore, the study of the philosophy of science as a basis for the development of scientific methods is relevant to ensure that science continues to develop responsibly and meaningfully.

METHOD

This article is written using a library research method. This method was chosen because it is appropriate for studying theoretical and philosophical concepts related to the philosophy of science and its development as the basis for scientific methods. The data used comes from secondary sources, such as books, scientific journals, articles, and academic documents that are relevant to the topic of discussion. The research stage begins with the collection of literature that discusses the philosophy of science, the basic concepts of scientific methods, and the relationship between the two. This literature is then analyzed critically to gain an in-depth understanding of how the philosophy of science contributes to the development of scientific methods, both in historical and contemporary contexts. The analysis is carried out using a descriptive-analytical approach, namely explaining the main concepts, then analyzing the relationship between the philosophy of science and the scientific method logically and systematically. This approach allows the author to explore various existing views and arguments, and to compile a synthesis that can provide a comprehensive understanding of the topic discussed.

FINDINGS AND DISCUSSION

Philosophy of Science and Research

Philosophy of science is a branch of philosophy that focuses on the study of the nature, purpose, and methods of science. As an epistemological foundation, philosophy of science provides a conceptual framework for understanding how humans construct, validate, and apply knowledge. In the context of research, philosophy of science serves as a guide to determining the appropriate paradigm, approach, and method in an effort to answer scientific questions. Philosophy requires habituation and practice to achieve the truth of the solution, which is a form of love for truth. A careful examination of an idea, issue, or substance will certainly produce useful results. Start by being unconventional. Radical Islam is defined by a general desire to seek guidance in understanding the root of the problem, rather than focusing its ideas on one phenomenon or set of facts. Believers should pay attention: extreme Islam reveals a desire to seek guidance in finding the truth (Joullié, 2016).

The nature of science according to the philosophy of science is rooted in three main pillars: ontology, epistemology, and axiology. Ontology discusses the nature of reality that is the object of scientific study. In research, ontological questions relate to what is considered to exist and worthy of study. For example, in social sciences, realities such as culture, behavior, and social relations are considered relevant entities to be explored. Epistemology, on the other hand, focuses on how to obtain valid knowledge. Scientific research requires a structured methodology to ensure that the knowledge produced is reliable, whether through quantitative, qualitative, or mixed approaches. Meanwhile, axiology highlights the values underlying science, such as honesty,

objectivity, and social relevance. In research, axiology reminds researchers to consider the ethical impact and benefits of the knowledge produced for society (O'Rourke et al., 2016).

Seeking the second principle, to understand the world, philosophers seek and analyze its most fundamental features. A famous Greek philosopher is known as the "natural philosopher." And then they will start collecting cosmic flowers because the question "isn't there only one principle behind diversity?" will pop into their heads. The truth sought or pursued is all that can be solved and reality. Third, the nature of the search for truth is the pursuit of truth itself. Ultimately, it is determined that having a foundation gives the ability to change one's situation. Philosophy becomes mystical or abstract when there is certainty; the fourth point is that in order to gain clarity, one must speak passionately to get rid of everything that is gloomy, confusing, dark, or doubtful. I see racial bias, haha. A methodical, analytical, and practical research strategy is needed for racial analysis (Townley, 2018).

Finding solutions to human problems is the ultimate goal of knowledge. There must be education to distinguish between good and evil in human life based on these facts. The established body of knowledge that distinguishes science from other disciplines is what makes the scientific community, according to one reference, a radical, introspective, and avid religion that supports all things knowledge and its relevance to every aspect of human life. When people talk about the "philosophy of science" as a subfield of science, they are referring to the subfield that studies knowledge-based science, which is closely related to laws and can be explained by them (Moon et al., 2019).

Increasing one's vitality is something that humans can learn and do. The ability to synthesize abstract concepts with concrete examples is unique to the human brain and is not found in other living things. The conclusions derived from reasoning are information, not emotions or feelings, and this is related to the thought process that reveals the real truth. The presence of ideas commonly called logic to determine its merits is one of the characteristics of reasoning. Examining this is what we call analysis.

One of the main contributions of the philosophy of science in research is the determination of paradigms. Research paradigms, such as positivism, constructivism, and pragmatism, reflect basic assumptions about reality and the best way to understand it. The ability to examine and analyze something critically before drawing conclusions is a human ability. In addition, all of this is done through the medium of spoken language. As a result, it is easy to see how subjective features can be enhanced. Related to this is the famous unique form, namely that humans are thinking creatures who are gifted with reason, able to distinguish between right and wrong, and gifted with the ability to change animal tendencies into human tendencies. Therefore, there are various views of philosophers on research which will be described as follows (Boon & Van Baalen, 2019).

First, positivism. August Comte is a leading figure in the positivist school of thought, who argues that the universe can be understood through scientific methods. This evidence is positive or factual. The political and social standards of a community can be inferred from the life experiences of its people. In addition, inductive reasoning is needed in this case. Comte's school

of philosophy, anti-metaphysics, accepted the facts provided by positive science and rejected the problematic ideas put forward by negative science. “To know in order to act” was one of Comte’s diplomatic mottos, translated as “saint pour prvoir.” Seizures could be better understood if individuals observed their symptoms and how they related to each other (Astini & Arsadi, 2021).

In August Comte’s “Cours de Philosophie Positive,” the principles of positivism were outlined. Comte is the source of positivism for many people around the world. To ensure that the analysis of a situation conducted under this framework is objective and based on reliable data, positivism as a research methodology relies on experimental design. Furthermore, it verifies data-based hypotheses. For something to be valid in science, according to Mohammad Muslih, it must be measurable, testable, and provable. Furthermore, it must hold up under scrutiny. Each of the three conclusions made in points 1, 2, and 3 is rooted in hard scientific data. Academic proposals are the subject of points 4 and 5. Based on these premises, positivism is essentially a quantitative, operational, and behavioral worldview. Quantitative studies are a natural outgrowth of positivism, which promotes the use of research tools that are based on facts and factual or empirical statements (Mayadah, 2022).

Second, constructivism. This school of thought rejects positivism and postpositivism as valid theoretical frameworks. Among the many hallmarks that underlie positivist theory are (Adom et al., 2016): (1) quantitative methods for data collection and analysis; (2) grounded theory to uncover relationships between quality indicators in field data; (4) scientific activities that are naturalistic and observational rather than laboratory-oriented and pre-arranged; (5) rigid and sterile research variables analyzed using learned patterns or response categories; (6) research that is more participatory and gives participants more control over their sources of information; and (7) a number of other features. Data collection methods that focus on construction, reconstruction, and elaboration include both dialectical and hermeneutical approaches. Qualitative research is thus an inevitable byproduct of the constructivist approach (Sawers et al., 2016).

Third, pragmatism. The term “pragmatism” comes from Greek. *Pragma* means doing something, while *tikos* means understanding. Thus, the study of practicality is known as pragmatism. When dealing with problems related to law, state, or business, pragmatic people will be calm. The word pragmatic can mean “correlation with practical things in English or” theoretical and ideas “in other languages. There is a direct correlation between findings and actions, not with economics or abstractions (Kaushik & Walsh, 2019). Another view is that pragmatism is a teaching that focuses on what is true is everything that is proven true through practical influence. Logic is the foundation of pragmatism. The practical influence that is beneficial to personal experience gained is caused by the assurance of mystical truth, which in turn results in the validation of the principle of mystical truth. Practical experience can be gained through the acquisition of useful experiences. Practical life skills are taught in this school. Because it combines all relevant ideas to understand the problem at hand, pragmatic research techniques are better at dealing with practical problems (Lohse, 2017).

Philosophy of science also emphasizes the importance of critical reflection in the research process. Researchers are encouraged to question the assumptions underlying their research,

whether related to the validity of the data, the reliability of the methods, or the social impact of their findings. Thus, philosophy of science helps prevent dogmatism in science and ensures that the research process remains dynamic and relevant. In the modern era, philosophy of science faces new challenges along with the development of technology and globalization. For example, the emergence of big data and artificial intelligence raises new epistemological questions about how data is collected, interpreted, and used to produce knowledge.

On the other hand, issues such as algorithmic bias and privacy violations highlight the importance of axiology in maintaining research ethics. Overall, philosophy of science is an inseparable foundation of research practice. Through an in-depth study of ontology, epistemology, and axiology, philosophy of science helps researchers not only produce valid and useful knowledge but also ensure that the research process is carried out responsibly. By integrating philosophy of science into research practice, science can continue to develop as a tool for understanding and advancing human civilization.

Scientific Method and Scientific Research

Observing the steps in the scientific process can help you understand science better. the steps scientists take in the scientific method to try to answer their problems. Thinking about something is the first step in finding a solution to a problem. The scientific process, which consists of well-defined steps, allows scientists to methodically uncover these benefits. The term "science" is reserved for certain types of data sets that meet certain requirements.

No body of knowledge can be called "science" unless it adheres to specific procedures that allow researchers to draw conclusions and make predictions. Perspective from an Islamic Perspective. The scientific method encompasses not only the process of learning but also any attempt to use it systematically to analyze events. "Meta" and "hodos" ("method") both come from Greek. The Greek words "meta" (meaning "toward, through, following, after") and "hodos" (meaning path, way, direction).

Approach as a series of steps to conduct research systematically. Another source states that research methods are systematic, logical, and objective ways of conducting scientific investigations: Research consists of seven stages: identifying a problem and translating it into a working hypothesis; developing a research plan; collecting data; evaluating and reporting the findings; and finally, publishing and disseminating the results. Science teaching methods can benefit students (Carpenter, 2018).

The scientific method is the way scientists conduct their investigations by observing phenomena and evaluating hypotheses. Additional statements by “Arturo Rosenblueth” include “educational methodology is a set of rules, procedures, and standards that teachers use to guide their students in developing their own unique knowledge.” When followed correctly, the scientific method produces knowledge. Scientists follow a precise protocol consisting of rules, classifications of tools, and methods that are carried out in an orderly, rational, and objective manner to gather scientific information (Ridwan et al., 2021).

Making observations is a major component in using the scientific method. When we talk about control, we mean the scientific focus when we are awake and alert, not when we are asleep. very similar to that used in scientific fantasy. This local government sets these rules in line with this scientific approach. This teaching method, on the other hand, utilizes the Research Method transparently. This research paradigm is derived from the evolving method. In addition, the author will outline the research technique using the findings of the individuals listed below. "Research" literally means "to trace back" in English, because it comes from the verb "re" which means "to search" and the noun "back" which means to trace back (Rashid et al., 2019).

The scientific method is a systematic framework used to gain knowledge through observation, experimentation, and critical analysis. As the backbone of scientific research, it ensures that the process of data collection, processing, and interpretation is conducted objectively and in a structured manner. Scientific research, on the other hand, is the application of the scientific method to answer a specific question or solve a problem based on verifiable evidence. Together, the scientific method and scientific research form the basis for the development of reliable and relevant knowledge (Adom et al., 2016).

The scientific method begins with the identification of a problem or research question. This stage involves observing a particular phenomenon and recognizing gaps in existing knowledge. For example, a researcher interested in climate change might ask, "How do urbanization patterns affect average temperatures in large cities?" Once the problem is formulated, the next step is to formulate a hypothesis, which is a tentative guess that can be tested. This hypothesis must be specific, measurable, and relevant to the problem at hand (Kaushik & Walsh, 2019).

The next stage is data collection through experiments or other appropriate methods. The data collected must be valid, reliable, and representative to ensure that the research results are credible. For example, in quantitative research, data is often collected through surveys, laboratory experiments, or statistical measurements. In contrast, qualitative research may involve in-depth interviews, field observations, or document analysis. At this stage, researchers must also ensure the use of appropriate tools and techniques to minimize bias and error.

Once the data is collected, the analysis and interpretation phase is carried out. In quantitative research, analysis usually involves statistical techniques to test hypotheses and determine relationships between variables. In qualitative research, analysis is carried out through the grouping of themes, interpretation of narratives, or in-depth study of emerging patterns. The results of this analysis are then interpreted to answer the research questions and support or reject the hypotheses that have been formulated (Eyisi, 2016).

The final stage of the scientific method is the publication and evaluation of the research results. Researchers are responsible for presenting their findings transparently through scientific reports, journal articles, or presentations at academic conferences. This process aims not only to disseminate knowledge but also to open up space for criticism and evaluation by the scientific community. Peer review is an important step to ensure that the research meets strict scientific standards (Sovacool et al., 2018).

Research is the exclusive domain of specialists. Geographical and systematic approaches to information acquisition are the basis of the technique. Research is defined as an activity that begins with the search for a topic and continues through its description, interpretation, and application. Research as "the activity of seeking information about something interesting or necessary to know". The definition of research in the Longman Dictionary of Contemporary English is "a serious study of a subject with the aim of discovering new facts or testing new ideas".

Every research requires at least one quantitative approach and two qualitative methodologies. Research that uses statistical procedures or other approaches beyond quantitative analysis to ascertain intangible qualities is known as qualitative research, according to Strauss and Corbin in John Creswell's explanation. As John Creswell says in Procedure textual and oral descriptions obtained from any and all observations of human behavior, customary practices, and the natural world are used in qualitative research. Five research methods used in qualitative research (narratology, phenomenology, ethnography, case studies, and grounded theory. Participatory action research techniques, often called cheek analysis. There are six different types of qualitative research: ethnography, case studies, document/text studies, field observations, hypothesis testing, phenomenology, theory building, and field research. Qualitative research methods include: narrative analysis, ethnography, phenomenology, case studies, grounded theory, discourse analysis, natural observation, short interviews, historical studies, reasoned theory, document/text/hermenetic studies, and participatory action (Levine et al., 2018).

In addition, there are quantitative methods considered solid and traditional in research because they are also known as positivist methods because they are based on a positivist point of view. To solve a problem, qualitative research aims to find the root cause, which means that a problem must be thoroughly investigated before researchers can find a solution (hypothesis). Data can be analyzed statistically or through the application of spss, Sem, and identical qualitative research. Quantitative research includes the following types of research: descriptive, correlational, ethnographic, quasi-expressive, and (5a) expressional. Other sources support research according to the quantitative approach, namely conducting surveys, analyzing data, conducting research, and evaluating findings. In general, there are several types of quantitative research that can be grouped together. These include: exploratory, descriptive, laboratory, causal, survey, field action research, classroom action research, developmental research, evaluation, and analytical descriptive (Schizas et al., 2016).

Scientific research using the scientific method has various types, depending on its purpose. Exploratory research aims to understand new phenomena and formulate initial hypotheses. Descriptive research focuses on describing certain characteristics or patterns in data. Experimental research, often considered the most robust form of scientific research, is designed to test cause-and-effect relationships through the manipulation of certain variables. Meanwhile, evaluative research is used to assess the effectiveness of certain programs or policies based on empirical data.

One of the main advantages of the scientific method is its ability to ensure that the knowledge produced is reliable and universally applicable. However, this method also has limitations. For example, in the humanities, the complexity and diversity of humans is often

difficult to reduce to numbers or variables that can be measured objectively. Therefore, an interdisciplinary approach that combines the scientific method with other approaches is often needed to comprehensively answer research questions (Kivunja & Kuyini, 2017).

In the modern era, technological advances such as artificial intelligence, big data, and advanced analytical techniques have opened up new opportunities in the application of the scientific method. For example, large-scale data analysis allows researchers to identify patterns that are not visible in manual observation. However, these advances also pose ethical challenges, such as data privacy and the potential for algorithmic bias. Therefore, it is important for researchers to adhere to ethical principles in research, such as transparency, fairness, and social responsibility (Maisarah et al., 2026).

The scientific method in research is a key pillar in the development of science. With a structured framework, the scientific method allows researchers to produce knowledge that is objective, verifiable, and useful for society. In facing increasingly complex global challenges, scientific research based on the scientific method remains the most effective tool for understanding and solving problems in various fields (Lestari et al., 2022).

The application of the scientific method in research not only contributes to the development of science, but also has a direct impact on various aspects of life. In the health sector, for example, research based on the scientific method has produced various medical innovations, such as vaccines, gene therapy, and precision medicine. Likewise in the technology sector, the scientific method has driven advances in artificial intelligence, quantum computing, and renewable energy, all of which have great potential to address global challenges such as climate change and food security.

However, the successful application of the scientific method depends heavily on the integrity of the researcher. In practice, threats to the validity of research can arise in various forms, such as data manipulation, plagiarism, or publication pressure that encourages invalid results. To address this, the scientific community has established various standards and codes of ethics for research (Samek et al., 2021). Research ethics emphasizes the importance of transparency, responsibility, and accountability, both in the process of data collection, analysis, and dissemination of results. In addition, it is important to create an environment that supports cross-disciplinary collaboration in research (Schmidt et al., 2019). Complex problems faced by the world today, such as the pandemic, the energy crisis, and social inequality, often require a multidimensional approach involving various scientific fields. Cross-disciplinary collaboration allows for the integration of different perspectives and methods, ultimately resulting in more holistic and innovative solutions (Karpatne et al., 2017).

On the other hand, education also plays an important role in strengthening the understanding and application of the scientific method. Educational curricula, especially at the tertiary level, should be designed in such a way as to equip students with the critical, analytical, and creative thinking skills needed to conduct scientific research. Training in research methodology, both theoretically and practically, helps create a generation of researchers who are able to face future challenges with an evidence-based approach. In a broader perspective, the

scientific method can also be applied outside the academic world to help the general public make more rational decisions. The use of scientific method principles in everyday life, such as healthy skepticism and hypothesis testing, can improve scientific literacy and empower the public to make decisions based on facts, not assumptions or rumors.

In the future, scientific methods and scientific research will continue to evolve along with technological advances and changing human needs. The use of technologies such as machine learning and advanced data analytics will further enhance researchers' ability to analyze large-scale data and make more accurate predictions. However, amidst these developments, it is important to maintain the basic principles of the scientific method: that knowledge must be based on verifiable evidence, and that the process of collecting and analyzing data must be carried out transparently and ethically. The scientific method and scientific research are complementary elements in the search for truth and problem solving. By integrating a scientific framework into research, researchers not only expand the boundaries of knowledge but also make a real contribution to the advancement of human civilization. In an increasingly complex and challenging world, the scientific approach remains the best tool for creating a better and more sustainable future for all.

CONCLUSION

These beliefs vary, including radical, basic, truth, explanation, and rational. The basis of knowledge is the process of investigation that seeks to establish facts so that the facts established through investigation have validity. In this investigation process there is a step called logic, which is a means to obtain true facts, and true knowledge requires logic. Worldview, which discusses schools or several paradigms, namely positivism, post-positivism, constructivism and pragmatism, influences the philosophy of research, leading to qualitative, quantitative and mixed research methods. These four views have an influence on the philosophy of research. To achieve a goal related to knowledge, the scientific method uses a systematic, logical and objective approach. This approach includes steps, procedures, patterns, labels, tools and techniques. The purpose of the research method is to find answers to a problem by collecting and analyzing data in various ways (eg logistic, systematic, planned, structured by recording, formulating and making reports based on scientific characteristics, namely rational, systematic and empirical), so that the desired results can be achieved.

REFERENCES

- Achadah, A., & Fadil, M. (2020). Filsafat Ilmu: Pertautan Aktivitas Ilmiah, Metode Ilmiah Dan Pengetahuan Sistematis. *Jurnal Pendidikan Islam*, 4(1), 130–141.
- Adom, D., Yeboah, A., & Ankrah, A. K. (2016). Constructivism Philosophical Paradigm: Implication For Research, Teaching And Learning. *Global Journal Of Arts Humanities And Social Sciences*, 4(10), 1–9.
- Astini, K. Y. W., & Arsadi, P. E. (2021). Perkembangan Akal Budi Manusia Pada Zaman Positifistik Dalam Perspektif Auguste Comte. *Vidya Darsan: Jurnal Mahasiswa Filsafat Hindu*, 2(2), 179–188.

- Boon, M., & Van Baalen, S. (2019). Epistemology For Interdisciplinary Research—Shifting Philosophical Paradigms Of Science. *European Journal For Philosophy Of Science*, 9(1), 16.
- Carpenter, S. (2018). Ten Steps In Scale Development And Reporting: A Guide For Researchers. *Communication Methods And Measures*, 12(1), 25–44.
- Dwisusila, D., Zaim, M., & Thahar, H. E. (2023). Filsafat Ilmu Sebagai Landasan Penelitian Sosial. *Jurnal Education And Development*, 11(2), 214–220.
- Eyisi, D. (2016). The Usefulness Of Qualitative And Quantitative Approaches And Methods In Researching Problem-Solving Ability In Science Education Curriculum. *Journal Of Education And Practice*, 7(15), 91–100.
- Joullié, J.-E. (2016). The Philosophical Foundations Of Management Thought. *Academy Of Management Learning & Education*, 15(1), 157–179.
- Karpatne, A., Atluri, G., Faghmous, J. H., Steinbach, M., Banerjee, A., Ganguly, A., Shekhar, S., Samatova, N., & Kumar, V. (2017). Theory-Guided Data Science: A New Paradigm For Scientific Discovery From Data. *IEEE Transactions On Knowledge And Data Engineering*, 29(10), 2318–2331.
- Kaushik, V., & Walsh, C. A. (2019). Pragmatism As A Research Paradigm And Its Implications For Social Work Research. *Social Sciences*, 8(9), 255.
- Kivunja, C., & Kuyini, A. B. (2017). Understanding And Applying Research Paradigms In Educational Contexts. *International Journal Of Higher Education*, 6(5), 26–41.
- Lestari, N. A., Fitriasia, A., & Ofianto, O. (2022). Keterkaitan Filsafat Ilmu Terhadap Ilmu Pengetahuan Dan Teknologi. *Jurnal Pendidikan Dan Konseling (JPDK)*, 4(6), 4585–4592.
- Levine, S., Pastor, P., Krizhevsky, A., Ibarz, J., & Quillen, D. (2018). Learning Hand-Eye Coordination For Robotic Grasping With Deep Learning And Large-Scale Data Collection. *The International Journal Of Robotics Research*, 37(4–5), 421–436.
- Lohse, S. (2017). Pragmatism, Ontology, And Philosophy Of The Social Sciences In Practice. *Philosophy Of The Social Sciences*, 47(1), 3–27.
- Maisarah, Rohman, N., Abidah, & Salleh, S. B. (2026). INTERNALIZING RELIGIOUS VALUES THROUGH HABITUATION AND MODELING METHODS IN SEKOLAH RENDAH INTEGRITAS TERAS ISLAM (SRITI) AL-QAWWAM. *JURNAL ILMIAH DIDAKTIKA: Media Ilmiah Pendidikan Dan Pengajaran*, 26(2), 171–186. <https://doi.org/10.22373/jid.v26i2.33128>
- Mayadah, U. (2022). Positivisme Auguste Comte. *Paradigma: Jurnal Kalam Dan Filsafat*, 2(01).
- Moon, K., Blackman, D. A., Adams, V. M., Colvin, R. M., Davila, F., Evans, M. C., Januchowski-Hartley, S. R., Bennett, N. J., Dickinson, H., & Sandbrook, C. (2019). Expanding The Role Of Social Science In Conservation Through An Engagement With Philosophy, Methodology, And Methods. *Methods In Ecology And Evolution*, 10(3), 294–302.
- O'Rourke, M., Crowley, S., & Gonnerman, C. (2016). On The Nature Of Cross-Disciplinary Integration: A Philosophical Framework. *Studies In History And Philosophy Of Science Part C: Studies In History And Philosophy Of Biological And Biomedical Sciences*, 56, 62–70.
- Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case Study Method: A Step-By-Step Guide For Business Researchers. *International Journal Of Qualitative Methods*, 18, 1609406919862424.
- Ridwan, M., Suhar, A. M., Ulum, B., & Muhammad, F. (2021). Pentingnya Penerapan Literature Review Pada Penelitian Ilmiah. *Jurnal Masohi*, 2(1), 42–51.

- Samek, W., Montavon, G., Lapuschkin, S., Anders, C. J., & Müller, K.-R. (2021). Explaining Deep Neural Networks And Beyond: A Review Of Methods And Applications. *Proceedings Of The IEEE*, 109(3), 247–278.
- Sawers, K. M., Wicks, D., Mvududu, N., Seeley, L., & Copeland, R. (2016). What Drives Student Engagement: Is It Learning Space, Instructor Behavior Or Teaching Philosophy? *Journal Of Learning Spaces*, 5(2).
- Schizas, D., Psillos, D., & Stamou, G. (2016). Nature Of Science Or Nature Of The Sciences? *Science Education*, 100(4), 706–733.
- Schmidt, J., Marques, M. R. G., Botti, S., & Marques, M. A. L. (2019). Recent Advances And Applications Of Machine Learning In Solid-State Materials Science. *Npj Computational Materials*, 5(1), 83.
- Sovacool, B. K., Axsen, J., & Sorrell, S. (2018). Promoting Novelty, Rigor, And Style In Energy Social Science: Towards Codes Of Practice For Appropriate Methods And Research Design. *Energy Research & Social Science*, 45, 12–42.
- Townley, A. L. (2018). Teaching And Learning Science In The 21st Century: Challenging Critical Assumptions In Post-Secondary Science. *Education Sciences*, 8(1), 12.