



The Role of Philosophy of Science in Developing Students' Critical and Creative Thinking Skills

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Abstract

The era of disruption, marked by technological revolutions, an information explosion, and complex social dynamics, calls for the emergence of Muslim intellectuals who are not only religious but also adaptable, critical, and creative. This article aims to analyze the strategic role of the Philosophy of Science course in developing students' critical and creative thinking patterns as a foundation for building adaptive intellectual capacity. The research employs a qualitative approach using the case study method, involving participatory observation in Philosophy of Science classes, curriculum document analysis, and in-depth interviews with fifteen students and five instructors. The research findings indicate that effective Philosophy of Science instruction serves as a metacognitive toolkit that empowers students, first to conduct critical analysis of the structure of knowledge, underlying assumptions, and the validity of arguments, whether in religious texts or contemporary issues; second, to develop intellectual creativity by formulating philosophical questions, mapping scientific problems in a multidisciplinary manner, and envisioning alternative solutions. The implications of this study indicate that the philosophy of science plays a very important role in fostering critical thinking among students, although in practice, some instructors still limit students' thinking by relying solely on a single argument.

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INTRODUCTION

Islamic Religious Universities serve not only as academic institutions but also as centers for shaping the scholarly and moral identity of the Muslim community. Since their inception, Islamic Religious Universities in Indonesia have played a vital role in integrating Islamic intellectual traditions with the needs of modern society. This role has become increasingly crucial as the education sector is required to produce graduates who not only master theory but also possess social sensitivity, adaptability, and the skills to navigate global changes. Consequently, Islamic Religious Universities are challenged to formulate learning strategies that are not only focused on preserving tradition but also on innovations relevant to the evolving times (Akhirin, 2015; Rosadi & Sitika, 2021; Sada et al., 2025; Sirin et al., 2021).

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Furthermore, the global dynamics of the 21st century require Islamic religious universities to strengthen their epistemological and methodological capacities in the learning process. Challenges such as the penetration of digital technology, massive information flows, and a shift in the knowledge paradigm from a single authority toward collaborative networks demand a new approach to Islamic higher education. In this context, reflective and philosophical courses, such as Philosophy of Science, become crucial for equipping students with the ability to assess the validity of knowledge, distinguish between facts and opinions, and develop a critical attitude toward various discourses circulating in the public sphere. In this way, Islamic higher education institutions can contribute more significantly to shaping a generation of Muslims who are not only religious but also intelligent, critical, and globally competitive.

Islamic Higher Education Institutions, including State Islamic Institutes, find themselves at a crossroads of complex challenges in the 21st century. On the one hand, they are tasked with preserving and transmitting the classical Islamic scholarly tradition. On the other hand, they face demands to respond critically and creatively to waves of disruption marked by advances in artificial intelligence (AI), the digital economy, a post-truth society, and global problems such as the ecological crisis and social polarization (Nuruzzaman, 2020). In this context, the formation of adaptive Muslim intellectuals those capable of understanding the complexities of the times, analyzing them with critical acuity, and offering innovative solutions grounded in Islamic values has become an urgent necessity (Azra, 2021).

However, reality shows that the output of Islamic higher education is often criticized for not yet being fully capable of addressing these challenges. Learning approaches that remain dominated by knowledge transfer (the “banking concept” of education) and rote memorization can hinder the development of higher-order thinking skills, such as critical and creative thinking (Fahri & Ma’ruf, 2021). This is where the Philosophy of Science course occupies a strategic yet problematic position. As a discipline that reflects on the foundations, methods, validity, and implications of knowledge, the Philosophy of Science has the potential to serve as a catalyst for fostering a reflective, analytical, and open mindset (Mudzakir, 2019). However, in many Islamic Religious Universities, the Philosophy of Science is often taught dogmatically, isolated from contemporary contexts, or even viewed with suspicion because it is considered a product of secular Western thought (Siregar, 2022).

This study focuses on the implementation and impact of the Philosophy of Science curriculum at the Institut Agama Islam Negeri (IAIN) Ternate. The choice of this location is particularly interesting because the Ternate State Islamic Institute operates within the unique sociocultural context of Eastern Indonesia, characterized by the dynamics of a multicultural society and specific development issues. The novelty of this article lies in its empirical-contextual analysis of the role of the Philosophy of Science at an Islamic Higher Education Institution in Eastern Indonesia, a topic rarely addressed in national academic discussions, Second, the development of a conceptual model for the teaching of the Philosophy of Science that integrates the Islamic epistemological framework (*bayani, burhani, irfani*), contemporary Western philosophical thought on science, and current issues of the disruption era relevant to students. This model is called the Epistemological Integration-Based Philosophy of Science Learning Model (MPF-IBIE).

METHODS

This research methodology employs a qualitative approach using a case study design to explore in depth the phenomenon of Philosophy of Science learning at Institut Agama Islam Negeri (IAIN) Ternate (Aryasutha et al., 2025; Busral et al., 2025; Creswell & Poth, 2018; Engkizar et al., 2022, 2023, 2025; Htay et al., 2025; Kassymova et al., 2025; Thuwaiba & Salaeh, 2025). The study was conducted from February to April 2024, utilizing various complementary data collection techniques. Participatory observation was conducted by attending 12 Philosophy of Science class sessions across two different programs of study, namely Ushuluddin and Sharia Economics. The researcher's presence in the classroom aimed to directly observe the dynamics of learning, interactions between instructors and students, and students' responses to the taught material.

In addition to observations, a document analysis was also conducted on the Semester Learning Plan (SLP), teaching modules, presentation materials, and student assignments. This analysis provides an overview of the curriculum structure, pedagogical approaches, and epistemological orientations used in the Philosophy of Science course. To deepen understanding, in-depth interviews using a semi-structured format were conducted with 15 students selected purposively based on variations in majors and academic achievement, as well as 5 instructors teaching the course. The interview questions focused on the perceptions of students and faculty, learning experiences, challenges faced, and the impact of learning on critical and reflective thinking. The interview findings were then enriched through a single Focus Group Discussion (FGD) session with eight students, which served as a forum to test data consistency and deepen the interpretation of collective experiences.

The collected data were analyzed using thematic analysis as outlined by (Braun & Clarke, 2006). The analysis process included stages of familiarization with the data, initial coding, theme identification, theme review, and finally the naming and reporting of relevant themes. To ensure data validity (trustworthiness), this study employed source triangulation (students, faculty, documents) and methodological triangulation (observation, interviews, documentation). Additionally, member checking was conducted by involving respondents to verify interview results, ensuring the researcher's interpretations align with participants' actual experiences. Through this combination of strategies, this study aims to produce a comprehensive, valid, and contextual picture of the implementation and impact of the Philosophy of Science course at the Institut Agama Islam Negeri (IAIN) Ternate.

RESULT AND DISCUSSION

The Implementation of the Philosophy of Science in Education and Its Impact on Thinking Patterns

The results of observations and interviews indicate that the teaching of the Philosophy of Science at the Institut Agama Islam Negeri (IAIN) Ternate generally covers core topics such as the definition and scope of the philosophy of science, ontology, epistemology, axiology, and various schools of thought (positivism and postmodernism). However, the teaching approach remains dominated by lectures and limited discussions. The impact on students' thinking patterns varies.

Impact on Critical Thinking: Most of the students interviewed acknowledged that this course forces them to "think more deeply" and "not easily accept

information.” They began to question assumptions that had previously been taken for granted, both in academic readings and in religious discourse circulating in society. This indicates the development of intellectual humility and a willingness to question, which are the foundations of critical thinking (Facione, 2020).

However, the ability to construct systematic and well-structured critical arguments remains weak. Essay assignments often consist of summaries of philosophers' views rather than critical analyses of them. This suggests that the leap from understanding philosophical concepts to applying them as tools for criticism remains a challenge.

Impact on Creative Thinking. The impact on creativity is more subtle. Five students reported that discussions about various philosophical schools opened their minds to the idea that *“truth can be viewed from many perspectives.”* This stimulates cognitive flexibility. In observations, it was noted that students began attempting to connect the concept of “verification” from positivism with the practice of verifying hadith, or Kuhn's concept of “paradigm” with shifts in schools of Islamic jurisprudence. This represents an early form of intellectual creativity connecting the dots between different fields.

However, opportunities for students to formulate original philosophical questions or propose imaginative solutions to contemporary problems remain very limited. The curriculum has not yet sufficiently addressed the aspect of “philosophy as an activity,” which emphasizes the practice of philosophy.

Challenges in Learning: Perception, Contextualization, and Methods

Research findings reveal several key challenges in learning: first, negative perceptions and anxiety. Some students, especially at the beginning of their studies, view the Philosophy of Science as a “difficult,” “abstract,” “impractical,” and even “dangerous” discipline because it is associated with skepticism and secular Western thought. *“At first I was afraid afraid my faith would waver,”* according to several informants. This perception becomes a significant psychological barrier.

Second is the dichotomy between Religious Studies and General Sciences. Although the paradigm of integration is touted, in teaching practice, the examples used are often still separate. Philosophy of Science is taught using examples from Western natural and social sciences, while its implications for the development of the epistemology of Islamic sciences are rarely addressed. As a result, students struggle to see the direct relevance (Abidin, 2024; AbuSulayman, 1989; Anshori, 2022; Bakhtiar, 2020).

Third, the conventional teaching method. Reliance on lectures and PowerPoint presentations makes the learning process passive. The limited use of concrete case studies from the era of disruption (for example, deepfake cases for discussions on reality, or biased recruitment algorithms for discussions on the ethics of science) makes the material feel disconnected from students' lives. Fourth, Faculty Capacity Limitations: Not all instructors have a deep background in philosophy, so teaching tends to be text-based and fails to facilitate a vibrant philosophical dialectic in the classroom.

Discussion of these findings indicates that the challenges in teaching Philosophy of Science at Institut Agama Islam Negeri (IAIN) Ternate are not merely technical, but also epistemological and cultural. Students' negative perceptions reflect a psychological distance between them and the discipline of philosophy, which could actually serve as a means of strengthening faith through

critical reflection. This calls for pedagogical strategies capable of transforming the image of philosophy from something “frightening” into something “enlightening.” For instance, by emphasizing that philosophy is not a threat to one’s beliefs but rather a tool for deepening understanding of Islamic teachings in a modern context.

The dichotomy between religious studies and general studies reveals that epistemological integration has not yet been fully realized in practice. In fact, the philosophy of science can serve as a bridge connecting the Islamic scholarly tradition with contemporary scientific developments. If instructors can present relevant examples from classical Islamic scholarship while linking them to modern problems, students will more easily recognize the relevance and urgency of the philosophy of science in real life. Thus, learning does not stop at mastering abstract concepts but evolves into practical analytical skills (Damanhuri, 2023; Fahri & Ma’ruf, 2021; Mudzakir, 2019; Munir, 2019; Rachman, 2023).

Conventional teaching methods also act as a barrier. When learning is centered solely on lectures and presentations, students tend to be passive and unmotivated to engage in dialogue. Yet, philosophy demands dialectics, healthy debate, and the exploration of ideas. The use of real-world case studies from the era of disruption can be an effective strategy to enliven the classroom. For example, discussing the phenomenon of hoaxes in a post-truth society or algorithmic bias in digital systems as an entry point to examine the epistemology and ethics of science. In this way, students will feel that the philosophy of science is directly connected to the realities they face in their daily lives.

The limitations of faculty members’ capabilities cannot be overlooked. Faculty members who lack a deep background in philosophy often struggle to facilitate critical discussions. As a result, learning becomes overly text-based and uninspiring. This highlights the need to strengthen faculty competencies through training, workshops, or collaboration with philosophy experts. With improved capabilities, faculty members can facilitate a learning process that is more interactive, reflective, and contextual.

Overall, these challenges underscore that the teaching of the Philosophy of Science at Islamic Higher Education Institutions, particularly at the Institut Agama Islam Negeri (IAIN) Ternate, requires a comprehensive transformation. This transformation encompasses changing students’ perceptions, integrating Islamic epistemology with modern science, innovating teaching methods, and enhancing faculty capacity. If these four aspects can be addressed, the Philosophy of Science has the potential to become a strategic course that not only fosters critical and reflective thinking but also strengthens the relevance of Islamic education in addressing the complexities of the era of disruption.

Toward an Adaptive Learning Model: A Proposal for the MPF-IBIE Model

Based on the findings and analysis of the challenges outlined above, this article proposes the Epistemic Integration-Based Philosophy of Science Learning Model (MPF-IBIE) for the context of the Institut Agama Islam Negeri (IAIN) Ternate and similar Islamic higher education institutions. This model is built on three main pillars: First, the Recontextualization of Material through an Epistemic Triangulation Approach. Western Philosophy of Science material (e.g., the epistemologies of empiricism, rationalism, and criticism) is not taught as the sole truth but is critically engaged with:

Classical Islamic Epistemology: Introducing the concepts of *bayani* (textual), *burhani* (demonstrative-rational), and *irfani* (intuitive) from Islamic philosophy (Al-Jabiri, 2009). For example, discussing how the *burhani* method (e.g., in the works of Ibn Rushd) intersects with and differs from the modern scientific method.

The Local Context of North Maluku: Linking discussions on “objectivity” and “value” in science to ethnographic research on conflict resolution in Maluku, or the concept of “local knowledge among indigenous communities from the perspective of the philosophy of science. Current Issues in the Age of Disruption: Using real-world cases such as ChatGPT (for a discussion of AI creativity vs. human creativity), religious hoaxes (for a discussion of the philosophy of truth and post-truth), or Sharia fintech (for a discussion of the ethics and axiology of science).

Second, the Activist-Reflective Learning Methodology. Shifting from a “teaching philosophy” to a “doing philosophy” through: Philosophical Inquiry Community: Forming small groups of students to investigate a philosophical problem (e.g., “Can clinical trials of halal drugs fully adopt the positivist paradigm?”) using simple research methodologies. Scenario-Based Learning: Encouraging students to analyze and argue within simulated scenarios (for example, as members of an ethics committee tasked with evaluating genetic engineering research on food crops). Critical Reading of Islamic Texts: Training students to read classical Islamic texts (e.g., Ibn Khaldun’s *Muqaddimah*) through the lens of the philosophy of science to identify the author’s ontological and epistemological assumptions (Fatah, 2023; Hakim, 2024; Hidayat, 2022; Husaini, 2020; Maarif, 2022).

Third, Critical-Creative Performance-Based Assessment. Assessment is not limited to theoretical essay exams but places greater emphasis on: Reflective Portfolio: A collection of students’ reflective writings on the application of philosophy of science analytical tools to issues they encounter in primary studies or daily life. Applied Philosophy Project: A final assignment in the form of a research proposal, a critique of campus policy, or a popular article that explicitly and creatively employs the perspective of the philosophy of science. Dialectics in Structured Debate: Assessing the ability to analyze arguments, identify fallacies, and construct logical rebuttals.

The MPF-IBIE model is designed to transform the Philosophy of Science from a “feared theoretical” course into a relevant, challenging, and empowering laboratory of reason. Through this model, it is hoped that students will not only understand philosophical schools of thought, but more importantly, be able to engage in philosophy to critique, create, and adapt to the complexities of the times as resilient Muslim intellectuals.

CONCLUSION

This study confirms that the study of the Philosophy of Science plays a strategic role in shaping the critical and reflective thinking of students at the Ternate State Islamic Institute. As a metacognitive toolkit, the Philosophy of Science enables students to analyze the structure of knowledge, test basic assumptions, and evaluate the validity of arguments in religious texts as well as contemporary issues. Furthermore, this course also fosters intellectual creativity by formulating philosophical questions, mapping scientific problems in a multidisciplinary manner, and envisioning alternative solutions relevant to the challenges of the era of disruption.

However, this study also identified barriers to implementation, such as students' negative perceptions, the dichotomy between religious studies and general sciences, monotonous teaching methods, and limitations in faculty capacity. These barriers have the potential to reduce the effectiveness of learning and limit the space for critical dialectics in the classroom. Therefore, a pedagogical transformation that is more contextual, integrative, and interactive is required.

A practical application of these findings is the need to develop a Philosophy of Science learning model that integrates Islamic epistemology with contemporary philosophy of science and current issues. Instructors can utilize case studies of phenomena in the digital age, ecological crises, and social problems as teaching materials to enhance relevance and student engagement. Furthermore, enhancing faculty capacity through training and collaboration with philosophy experts is a crucial step to ensure that learning is not merely textual but also dialogic and inspiring. Thus, the Philosophy of Science can function optimally as the foundation for shaping Muslim intellectuals who are critical, creative, and adaptable to the complexities of the modern era.

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Author contribution

Rifadli Amin DG. M: data curation, writing-original draft preparation, **Nurasma Ila Ismail:** conceptualization, methodology, **Mustamin Giling:** visualization, editing, analysis.

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