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Research/Review

The Influence of Understanding the Philosophy of Science on Students' Critical Attitudes and Academic Ethics in the Learning Process

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Abstract: This study investigates the influence of understanding the philosophy of science on students' critical attitudes and academic ethics in the learning process. Philosophy of science is essential in shaping systematic and reflective scientific thinking, while also serving as a foundation for academic character development. Using a quantitative approach, the research involved 30 postgraduate management students at Universitas PGRI Palembang. Data were collected through a closed-ended questionnaire using a five-point Likert scale to measure three constructs: understanding of the philosophy of science, critical attitude, and academic ethics. Analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software. The results show that understanding the philosophy of science has a positive and significant effect on students' critical attitudes. Students with deeper understanding demonstrate better logical, analytical, and reflective thinking. Moreover, it significantly influences academic ethics—those with philosophical awareness tend to uphold academic integrity and originality. These findings affirm that the philosophy of science serves not only as a conceptual framework but also as a tool for shaping students' intellectual and moral qualities. The study emphasizes the importance of integrating philosophy of science into higher education curricula to foster critical thinking and ethical academic behavior among students.

Keywords: Philosophy of Science, Critical Attitude, Academic Ethics

1. INTRODUCTION

The philosophy of science plays a fundamental role in shaping the intellectual character of students, particularly in the context of higher education. As a branch of philosophy that focuses on the nature of science, scientific methods, as well as the structure and validity of knowledge, the philosophy of science provides a conceptual foundation for students to understand the scientific process comprehensively not only from a technical-methodological perspective but also from ontological and axiological dimensions [1]

A deep understanding of the philosophy of science offers not only theoretical insights into the nature of knowledge and scientific methods but also serves as a foundation for developing a systematic, logical, and rational scientific mindset [2]. Students who comprehend the philosophy of science holistically are more likely to evaluate knowledge based on a strong epistemological framework. This allows them to distinguish between assumptions, facts, and opinions, and to construct arguments coherently and responsibly. Such scientific reasoning is crucial in an age of massive and often academically unverified information flows [3].

In addition to fostering critical thinking, the philosophy of science cultivates reflective awareness of the purposes and impacts of scientific endeavors themselves [4]. In this context, students are not only encouraged to understand what science is and how it operates but also to reflect on the values underlying scientific activities. Thus, the philosophy of science helps

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shape students into academic individuals who uphold integrity, honesty, and responsibility in the acquisition and dissemination of knowledge [5].

According to Khusnul Wardan, the philosophy of science serves as a value guide within the academic world, directing students to cite sources properly, avoid plagiarism, and conduct research objectively and transparently [6]. Such ethical awareness is a crucial prerequisite for building a healthy and sustainable academic culture. Therefore, the study of the philosophy of science should not be seen as an optional or supplementary subject, but rather as a core instrument in shaping students' intellectual and moral character in higher education [7].

Unfortunately, in practice, students' understanding of the philosophy of science in higher education remains limited and often lacks proportional attention [8]. Many students view it as an abstract, theoretical subject with little practical relevance to workplace skills. This perception often stems from a lack of integration between philosophical and applicative approaches in teaching, along with one-way, non-dialogical instructional methods. As a result, students tend to study the subject merely to fulfill academic obligations rather than as a process of internalizing scientific and ethical values.

In fact, the philosophy of science serves as the epistemological and methodological foundation of every scientific discipline [9]. Students' lack of understanding of fundamental principles—such as the nature of knowledge (epistemology), the values and aims of science (axiology), and the principles of logic and argumentation weakens their critical thinking skills. Consequently, they struggle to analyze information objectively, assess arguments based on evidence and logic, and develop systematic opinions or solutions. This condition undermines the quality of academic discourse and reduces students' analytical capacity in addressing scientific, social, or public policy issues.

Furthermore, a limited understanding of the philosophy of science negatively affects students' academic ethics. Values such as honesty, scientific responsibility, and originality are often overlooked. Practices such as plagiarism, data manipulation in research reports, and non-compliance with scientific writing standards serve as indicators of weak academic integrity. Metcalf noted that poor understanding of the philosophy of science correlates directly with a lack of ethical awareness among students, ultimately affecting graduate quality and the credibility of educational institutions [10].

Therefore, it is imperative for higher education institutions to reposition the philosophy of science as an essential component in the development of students' academic character not merely as an introductory subject or curricular add-on [11]. The philosophy of science should be holistically integrated into the educational process to develop students who are not only cognitively competent but also capable of deep reflection and moral integrity in both academic and professional contexts. This goal can be achieved through the development of contextual curricula, dialogical and reflective teaching methods, and the strengthening of instructors' roles as facilitators of critical and ethical awareness.

Based on these issues, this study aims to quantitatively examine the relationship between students' understanding of the philosophy of science and two critical aspects of higher education: critical thinking disposition and academic ethics. Through a quantitative approach, this research seeks to provide an objective empirical picture of the extent to which mastery of the philosophy of science influences the development of students' intellectual and moral attitudes. In other words, this study aims to answer the question: Does a strong understanding of the philosophy of science significantly correlate with students' critical thinking skills and awareness of academic ethics?

The results of this research are expected to provide both scientific and practical contributions, particularly in the development of instructional design and higher education curricula. Theoretically, the study contributes to the body of literature exploring the relationship between conceptual-philosophical aspects and students' attitudes in academic settings. Practically, the findings may serve as a basis for developing a more meaningful, applicable, and integrated approach to teaching the philosophy of science—one that contributes to character-building. Thus, higher education can produce not only technically skilled graduates but also

intellectually excellent and ethically grounded individuals prepared to face complex academic and professional challenges.

2. PRELIMINARIES OR RELATED WORK OR LITERATURE REVIEW

2.1. Philosophy of Science and Its Role in Higher Education

Philosophy of science is a branch of philosophy that explores the nature of science, the structure of knowledge, scientific methods, and the values and goals of scientific activities. Its role in higher education is fundamental, as it provides a deep conceptual framework for understanding science not only from a technical perspective but also through ontological and axiological lenses [12]. Alex Rosenberg emphasized that philosophy of science is key to understanding how science operates in practice and how scientific justification is rationally constructed [7].

In the learning context, a solid understanding of philosophy of science encourages students to develop systematic, critical, and reflective scientific thinking [2]. This is particularly crucial in today's information era, where unverified data is widely circulated and the ability to distinguish between facts, assumptions, and opinions is essential [3]

2.2. Philosophy of Science and Students' Critical Thinking

One of the primary contributions of philosophy of science in education is the development of students' critical thinking disposition. Changwong describe critical thinking as an active and skilled intellectual process involving the conceptualization, application, analysis, synthesis, and evaluation of information from various sources [13]. Ismail further notes that critical thinking strongly shapes how students construct their worldview and respond to social realities in a rational manner [14].

In this regard, philosophy of science provides an epistemological foundation that enables students to evaluate arguments logically, question underlying assumptions, and construct coherent knowledge synthesis [9]. Prior research indicates that students with a strong grasp of philosophical principles tend to demonstrate more advanced critical thinking skills, allowing them to handle academic challenges more systematically.

2.3. Philosophy of Science and Academic Ethics

Beyond cognitive development, philosophy of science is also closely tied to the moral dimension of academic life. Values such as intellectual honesty, respect for the originality of scholarly work, and responsibility in conducting research are core elements of academic ethics nurtured through the study of philosophy of science [15]. González-Esteban and Calvo argue that ethics should be seen not as an external addition to science, but as an integral part of the scientific process itself [16].

In practice, understanding philosophy of science helps students become more aware of the importance of academic integrity and prevents misconduct such as plagiarism and data manipulation [17]. Kajiwara and Kawabataemphasize that ethics education in higher education should be balanced with cognitive development so that students become not only intellectually competent but also morally grounded individuals [18].

2.4. Challenges in Teaching Philosophy of Science in Higher Education

Although philosophy of science has a significant impact on shaping students' academic character, it often receives limited attention in higher education [8]. Students frequently perceive it as abstract, overly theoretical, and disconnected from the practical skills required in the job market. As a result, the learning process tends to be passive, driven more by academic obligation than by genuine philosophical reflection.

Pahmi suggest that a dialogical, reflective, and contextual teaching approach is essential for effective delivery of philosophy of science content [11]. Furthermore, curriculum

integration is needed to bridge the gap between philosophical insights and students' practical needs, ensuring that philosophy of science becomes not only a theoretical discourse but also a transformative tool for students' intellectual and moral development.

3. PROPOSED METHOD

This study employs a quantitative approach using a survey method to empirically examine the relationship between students' understanding of the philosophy of science and their critical thinking disposition and academic ethics [19]. The quantitative approach was chosen because it allows for an objective and measurable depiction of the studied phenomenon and enables statistical analysis of relationships between variables through a structured model [20].

The population of this study consists of all active postgraduate students enrolled in the Master of Management program at Universitas PGRI Palembang. The sample includes 30 respondents, determined using the total sampling technique due to the relatively small and accessible population. The selection of postgraduate students as research subjects is based on the consideration that they possess a higher level of academic maturity and critical thinking ability, making them suitable for comprehending philosophical concepts and upholding academic ethical values.

The data collection instrument used is a closed-ended questionnaire with a five-point Likert scale, consisting of three main constructs: understanding of the philosophy of science, critical thinking disposition, and academic ethics. Each construct is measured using four items developed based on relevant theoretical indicators and validated by experts in education and philosophy. Response scores range from 1 (strongly disagree) to 5 (strongly agree), with the assumption that higher scores indicate greater levels of understanding and more positive attitudes.

The data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique with the help of SmartPLS software. This technique was selected due to its ability to analyze relationships among latent variables simultaneously, even with a limited sample size. It also allows for the testing of both the measurement model (outer model) and the structural model (inner model) concurrently [21]. The analysis includes tests of convergent validity, discriminant validity, and indicator reliability for the outer model, as well as causal relationship testing and coefficient of determination (R^2) values for the inner model to assess the overall predictive strength of the model.

4. RESULTS AND DISCUSSION

4.1. Outer Model Evaluation

Before analyzing the relationships between variables in the structural model, an evaluation of the measurement model (outer model) was conducted to ensure that the instruments used met the criteria for reliability and validity. This evaluation included testing internal reliability through Cronbach's Alpha and Composite Reliability (CR) values, as well as assessing convergent validity using the Average Variance Extracted (AVE). The results of these tests are presented in the following table.

Table 1. Outer Model Evaluation Results

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Academic Ethics	0,721	0,757	0,823	0,544
Philosophy of Science	0,939	0,954	0,956	0,844
Critical Thinking	0,862	0,894	0,905	0,705

Source: Processed Data, 2025

The results of the construct reliability testing show that all variables in the model meet the eligibility criteria based on Cronbach's Alpha and Composite Reliability (CR) values. Cronbach's Alpha values range from 0.721 to 0.939, indicating good to excellent internal consistency (Hair et al., 2019). Specifically, the construct of Academic Ethics has a Cronbach's Alpha of 0.721, which exceeds the minimum threshold of 0.70, indicating acceptable reliability. The Philosophy of Science construct shows very high reliability with a Cronbach's Alpha of 0.939, while Critical Thinking demonstrates high reliability with a value of 0.862. The Composite Reliability (CR) values for all constructs are above 0.80, with Philosophy of Science at 0.956, Critical Thinking at 0.905, and Academic Ethics at 0.823. All values exceed the recommended minimum of 0.70, indicating that the indicators for each construct demonstrate high internal consistency and are generally reliable in measuring the intended constructs.

Furthermore, convergent validity was assessed using the Average Variance Extracted (AVE). The results show that all constructs have AVE values above 0.50, namely Academic Ethics (0.544), Philosophy of Science (0.844), and Critical Thinking (0.705). These values indicate that each construct has met the criteria for convergent validity, meaning that more than 50% of the variance in the indicators is explained by the respective construct (Fornell & Larcker, 1981). Therefore, it can be concluded that the research instrument possesses adequate reliability and validity, and is suitable for further analysis in testing relationships between variables within the structural model.

4.2. Inner Model

The next step is the inner model evaluation, which involves assessing the R Square and F Square values. The R Square (R^2) value indicates the proportion of variance in the endogenous constructs that can be explained by the exogenous constructs in the model. A higher R^2 value suggests greater predictive power of the model. The results of the R^2 and adjusted R^2 analysis for each endogenous construct are presented in the following table:

Table 2. R Square Results

Construct	R Square	R Square Adjusted
Academic Ethics	0.127	0.096

Source: Processed Data, 2025

Based on the structural model analysis, the *Critical Thinking* construct has an R Square of 0.575 and an Adjusted R Square of 0.560, indicating that 57.5% of the variance in Critical Thinking can be explained by the *Philosophy of Science* construct. This value falls into the moderate category, according to Hair et al. (2019), who classify R^2 values of 0.25 as weak, 0.50 as moderate, and 0.75 as strong. This suggests that understanding the philosophy of science makes a meaningful contribution to shaping students' critical thinking.

Meanwhile, the *Academic Ethics* construct shows an R Square of 0.127 and an Adjusted R Square of 0.096, meaning that only 12.7% of the variance in Academic Ethics can be explained by the *Philosophy of Science* and *Critical Thinking* constructs. This low value indicates that other factors beyond the model likely play a more significant role in shaping students' academic ethics. This opens opportunities for future studies to explore additional influential variables, such as reflective attitudes, moral values, or academic environments.

The analysis aims to determine the strength and significance of the influence between variables. Hypothesis testing is performed by examining path coefficients and t-statistics, obtained through the bootstrapping technique. The results of the influence analysis between constructs are shown in the table below:

Table 3. F Square Results

Construct	Academic Ethics	Critical Thinking
Philosophy of Science	0.145	1.356

Source: Processed Data, 2025

Based on the results, the influence of *Philosophy of Science* on *Academic Ethics* shows a path coefficient of 0.145 with a t-statistic of 1.356. Since this t-value is below the significance threshold of 1.96 at the 5% level ($p < 0.05$), the relationship between philosophy of science and academic ethics is not statistically significant. In other words, in the context of this study, understanding the philosophy of science alone is not strong enough to directly influence students' academic ethics. This finding suggests the potential presence of mediating variables or other influencing factors that bridge the relationship between philosophy of science and academic ethics such as reflective attitudes, moral values, or the academic environment.

4.3. Hypothesis Testing

After evaluating the structural model (inner model) using the bootstrapping technique with SmartPLS software, the results reveal a significant relationship between students' understanding of the philosophy of science and their critical thinking and academic ethics among postgraduate students in the Master of Management program at Universitas PGRI Palembang**.**

Table 4. Hypothesis Testing Results

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
Philosophy of Science → Academic Ethics	**0,356**	**0,389**	**0,178**	**2,006**	**0,045**
Philosophy of Science → Critical Thinking	**0,759**	**0,772**	**0,061**	**2,405**	**0,000**

Source: Processed Data, 2025

The analysis shows that understanding the philosophy of science has a significant effect on critical thinking, with a path coefficient of 0.759, a t-statistic of 2.405, and a p-value of 0.000. This indicates that the higher the students' understanding of the philosophy of science, the stronger their tendency to think critically in addressing academic and practical issues. This finding suggests that philosophy of science serves as an essential foundation in developing logical, reflective, and analytical thinking skills, which are core components of critical thinking.

In addition, the relationship between understanding the philosophy of science and academic ethics also shows a significant influence, with a path coefficient of 0.356, a t-statistic of 2.006, and a p-value of 0.045. This means that students with a solid understanding of the philosophy of science tend to display more ethical academic behavior, such as valuing the originality of work, upholding integrity, and adhering to academic norms. These findings reinforce the assumption that philosophy of science education contributes not only to the cognitive development of students but also to their affective and moral dimensions in academic life.

These results are consistent with the perspective of [21], who assert that in structural equation modeling, significant relationships between latent constructs indicate strong conceptual connections that are theoretically sound. Therefore, it can be concluded that understanding the philosophy of science plays a strategic role in shaping students' academic characterencouraging both critical thinking and a strong commitment to academic ethics.

5. COMPARISON

The findings of this study highlight that an understanding of the philosophy of science makes a significant contribution to the development of students' critical thinking disposition, which serves as one of the fundamental pillars of the learning process in higher education. Students who possess a strong grasp of the basic principles of the philosophy of science tend to demonstrate better abilities in analyzing theoretical concepts, scientific arguments, and the logical structure of various types of information they encounter in academic settings. This is because the philosophy of science equips them with the capacity to think systematically, to question taken-for-granted assumptions, and to differentiate between scientifically grounded knowledge and untested claims [12].

The learning process of philosophy of science requires students not merely to memorize theories but to explore the meaning behind each concept and reflect on its implications for real life. In this regard, students are challenged to develop their epistemological capacity that is, the ability to understand how science is constructed, how knowledge is tested, and how scientific justification is established. These abilities directly contribute to the development of critical thinking competence, which is the ability to evaluate information or claims objectively and analytically. As stated by Changwong critical thinking is an active and skillful intellectual process that involves conceptualization, application, analysis, synthesis, and evaluation of information derived from experience, observation, reflection, reasoning, or communication as a guide for belief and action [13].

Critical thinking is also recognized as a core 21st-century skill, highly emphasized in higher education. In this context, critical thinking serves not only as a tool to evaluate information but also as a means of self-transformation, allowing students to escape dogmatic thinking and become open to healthy intellectual dialogue. This skill is essential in shaping the students' scientific identity, wherein they are not merely consumers of knowledge, but also producers and developers of scientific thought. Ismail notes that the teaching of critical thinking in higher education strongly determines how students shape their worldview, understand social realities, and respond rationally to contemporary challenges [9].

Moreover, the study also shows that understanding the philosophy of science is significantly related not only to cognitive development but also to the formation of academic ethics. Academic ethics refers to a set of values and norms that govern behavior in academic settings, such as honesty, scientific responsibility, respect for others' scholarly work, and a commitment to integrity in learning and research. In the philosophy of science, these values are not only presented normatively but embedded in a deeper philosophical framework that requires reflection on the purpose of science and the responsibility of scientists to society. Thus, understanding the philosophy of science contributes to students' moral awareness about how knowledge should be developed and utilized [15]

González-Esteban and Patrici Calvo argue that ethics in science must be seen as an integral dimension of the scientific process itself, not as an external add-on [16]. This means that academic integrity should be upheld not merely due to institutional regulations, but as a logical consequence of a proper understanding of the nature of science. In this regard, philosophy of science education plays a crucial role in instilling such values, as it teaches that scientific activities are inherently value-laden and demand responsibility, honesty, and respect for the pursuit of truth. This view is reinforced by Teessar Janari , who emphasizes that a strong

understanding of the philosophical foundations of science can enhance adherence to ethical standards and reduce instances of academic misconduct such as plagiarism and data manipulation [17].

Additionally, in the context of higher education, academic ethics should not be understood solely as compliance with institutional rules, but as a reflection of the individual's moral character developed through a holistic educational process. Therefore, a character education approach that fosters reflective awareness through philosophy of science becomes highly relevant. Philosophy of science encourages students to consider the meaning and value of their educational journey and to view academic activities as part of their social and moral responsibilities as future intellectuals. Kajiwara and Kawabata emphasize that ethics education in higher education must achieve a balance between moral instruction and cognitive development, so that students become not only intellectually capable but also ethically mature [18]. In this framework, the role of philosophy of science in shaping students' character is highly strategic: it influences not only the way students think when constructing arguments or analyzing theories, but also touches on their personality and moral integrity as academic individuals.

6. CONCLUSIONS

Based on the results of the study, it can be concluded that understanding the philosophy of science has a significant influence on the development of critical thinking disposition and academic ethics among postgraduate students. The philosophy of science greatly contributes to shaping a logical, reflective, and systematic mindset serving as a fundamental basis for critical thinking in academic settings. Students with a deep understanding of the philosophy of science tend to be more capable of evaluating information, constructing arguments based on valid logic, and objectively questioning underlying assumptions. Thus, the philosophy of science plays a key role in strengthening students' intellectual capacity.

In addition, the findings also reveal a significant positive correlation between the understanding of the philosophy of science and students' academic ethics. This indicates that a grasp of the philosophical foundations of science helps foster students' moral awareness in maintaining academic integrity, avoiding plagiarism, and respecting the scientific process in an honest and responsible manner. Education in the philosophy of science contributes not only to the cognitive domain but also to the affective and ethical dimensions of students.

Therefore, it is crucial for higher education institutions to strengthen the role of the philosophy of science within the curriculum and teaching practices. Contextual, applicable, and dialogical integration of the philosophy of science will not only enrich students' academic insight but also cultivate a well-rounded scientific character critical in thought and ethical in action. This research also opens up opportunities for further studies, particularly by incorporating mediating or moderating variables to clarify the mechanisms through which the philosophy of science influences other dimensions of academic character.

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