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Artificial intelligence literacy and academic wisdom among secondary school students: a structural equation modelling study in Indonesia

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ABSTRACT

The rapid integration of artificial intelligence (AI) in secondary education has created a paradox between high adoption and limited critical-ethical readiness, raising concerns about students' academic integrity and cognitive autonomy. This study addresses the lack of empirical evidence on how multidimensional AI literacy contributes to the development of academic wisdom. Using a quantitative explanatory design, survey data were collected from 396 secondary school students in Indonesia and analyzed using generalized structured component analysis-structural equation modeling. AI literacy was operationalized into three dimensions: technical, critical, and ethical literacy. The results reveal that all dimensions significantly influence academic wisdom, with ethical literacy emerging as the strongest predictor (β=0.354), followed by critical literacy (β=0.322) and technical literacy (β=0.170). The model explains 43.9% of the variance and demonstrates good fit indices (goodness of fit index=0.986; Std. root mean square residual=0.041). These findings indicate that academic wisdom is primarily shaped by students' ability to critically evaluate and ethically regulate AI use rather than by technical competence alone. The study extends the data information knowledge wisdom framework by positioning ethical literacy as a key mechanism transforming knowledge into wisdom and offers implications for curriculum design emphasizing ethical and critical competencies in AI-integrated learning.

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1. INTRODUCTION

The rapid integration of generative artificial intelligence (AI) has precipitated a crucial paradigm shift in the secondary education ecosystem, marking the era of large-scale intellectual automation. This phenomenon represents more than a mere technical substitution; it is a fundamental disruption shaking the pillars of knowledge creation, authenticity, and scientific accountability [1]. In Indonesia, platforms such as ChatGPT and Gemini have proliferated among students to assist with tasks ranging from academic writing to programming [2]. The rapid diffusion of digital communication platforms has also influenced the linguistic practices of Generation Z, whose language patterns in online environments often reflect adaptive phonological transformations and informal discourse styles [3]. While these tools optimize productivity, unchecked reliance raises significant concerns regarding the atrophy of critical thinking skills and diminished cognitive engagement, without deep reflection, students risk becoming passive recipients of algorithmic

output. Students' interaction patterns in modern classrooms are increasingly shaped by generational communication styles, where Generation Z tends to respond to instructional prompts with distinctive language attitudes that reflect digital-era learning behaviors [4].

Table 1 presents the comparison of AI literacy perceptions and educational readiness indicators between Indonesia and global OECD contexts [5]. Despite high optimism toward AI integration in education, Indonesia continues to face significant challenges in terms of digital literacy readiness, educational infrastructure, and teacher preparedness. This condition reflects the "Indonesian AI Paradox," where rapid AI adoption is not fully supported by sufficient critical understanding and institutional readiness [6]. The gap between technological adoption and literacy readiness raises concerns that students may become passive recipients of algorithmic outputs rather than reflective learners capable of critically evaluating AI-generated information. Within the data-information-knowledge-wisdom (DIKW) hierarchy, AI systems demonstrate strong capabilities in processing data and generating information efficiently, yet the transformation of information into knowledge and wisdom still depends on human judgment, contextual reasoning, and ethical reflection [6]. Figure 1 illustrates the paradoxical relationship between high AI optimism and limited educational readiness in Indonesian secondary schools. This describes how the optimism towards AI benefits and teacher training requirements in Indonesia need to be fulfilled more than global OECD. Academic wisdom therefore requires the integration of critical thinking, ethical awareness, and technical literacy. Figure 1 illustrates the imbalance between AI optimism and educational readiness within the Indonesian context.

Table 1. Comparison of perceptions of benefits and challenges of AI literacy in Indonesia (2025 projection)

Literacy and adoption indicators	Global (OECD)	Indonesia	Data source
Optimism about the benefits of AI in education	36%-54%	80%	[7], [8]
Adoption rate of generative AI tools	16.3%	14.1%	[9], [10]
Basic literacy score (PISA 2022)	472-476	359-383	[11]
School IT infrastructure gaps	25%	85%	[6]
AI teacher training needs	50%	81%	[6], [12]

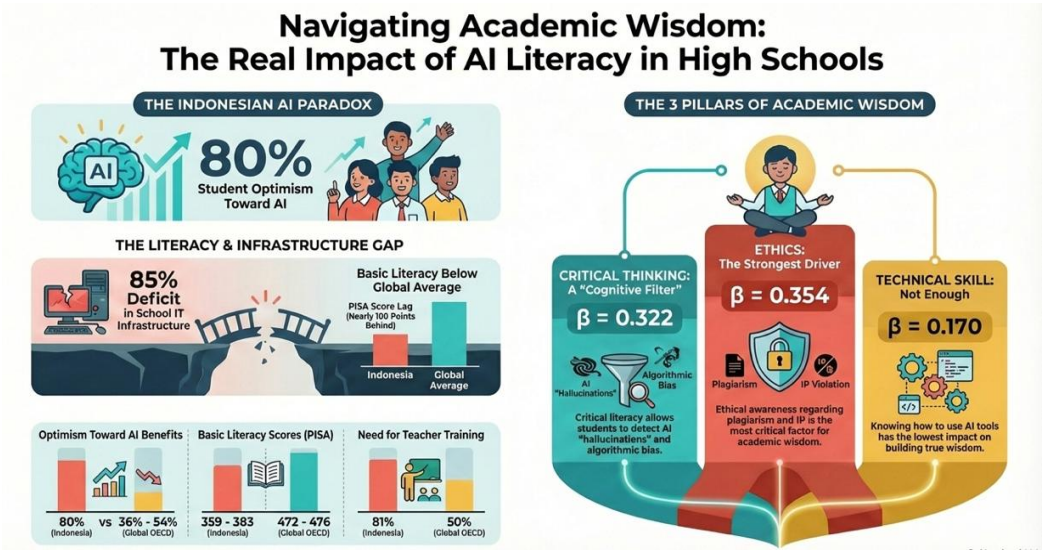


Figure 1. The real impact of AI literacy in high school [11]

However, a significant research gap remains. Prior studies have largely focused on the technical adoption of AI or its immediate impact on grades, rarely empirically mapping how multidimensional AI literacy transforms into academic wisdom among high school students [13]. Furthermore, existing literature lacks robust statistical modeling, such as structural equation modeling (SEM), to quantify the relationship between technical skills, critical thinking, and ethical awareness in forming a defense mechanism for educational integrity. Figure 2 presents the conceptual transition from information processing toward academic wisdom within the DIKW hierarchy.

Despite the urgency of this issue, existing literature has largely focused on technical adoption and functional efficiency, often overlooking the complex interplay of ethics and wisdom. This leaves a critical gap in understanding how multidimensional literacy empirically shapes academic wisdom within the high

school ecosystem. To address this scarcity and navigate the prevailing Indonesian AI Paradox, recent pedagogical innovations in Indonesian secondary education also emphasize differentiated learning strategies that enable students to develop higher-order thinking skills through adaptive instructional design [14]. This study formulates three key research questions (RQs):

- How do the distinct dimensions of AI literacy (technical, critical, and ethical) influence the formation of academic wisdom among high school students? (RQ1)
- Amidst the infrastructure deficit, to what extent do critical thinking and ethical awareness act as "cognitive filters" compared to mere technical skills? (RQ2)
- How can the integration of these literacy pillars effectively bridge the "Indonesian AI Paradox" and transform algorithmic output into human wisdom within the DIKW framework? (RQ3)

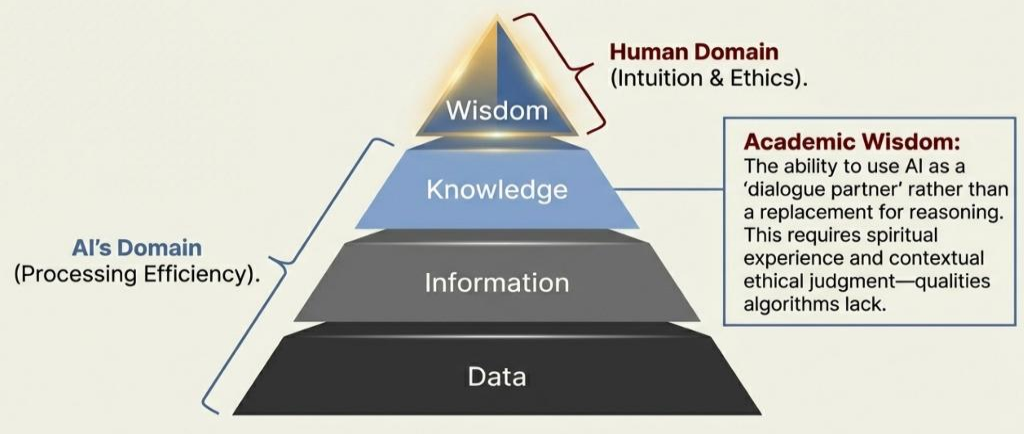


Figure 2. Moving beyond information to academic wisdom [9]

To address this gap, the present study adopts the DIKW framework as the theoretical foundation for understanding the relationship between AI literacy and academic wisdom. Within this framework, AI literacy is conceptualized not merely as technical proficiency, but as a multidimensional competency that enables students to critically evaluate, ethically regulate, and effectively utilize AI technologies in academic environments [15], [16]. Contemporary frameworks have shifted from tool-centric perspectives toward holistic competency models emphasizing technical, critical, and ethical dimensions of AI literacy [17]. Critical literacy emphasizes students' ability to evaluate the validity, reliability, and potential bias of AI-generated content, particularly because generative AI systems may produce inaccurate or misleading information. Ethical literacy functions as the moral foundation guiding responsible AI use, including awareness of plagiarism, intellectual property, data privacy, and academic integrity [18]. Meanwhile, technical literacy provides a conceptual understanding of algorithmic mechanisms, data limitations, and machine learning processes, enabling students to recognize both the capabilities and limitations of AI systems.

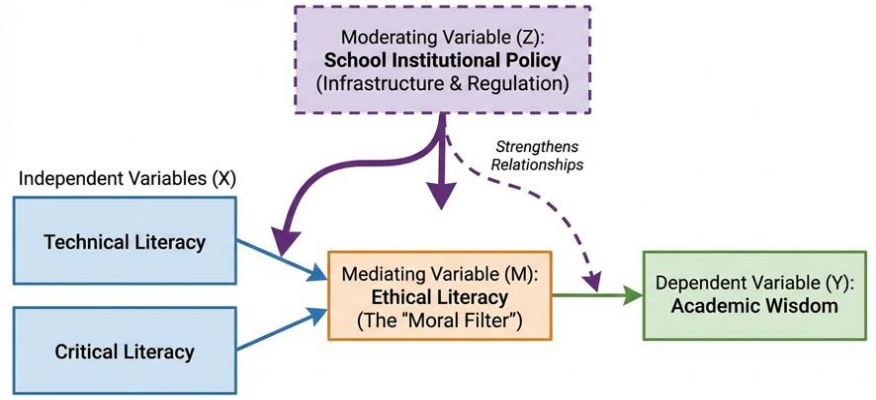
In this study, academic wisdom is conceptualized as the highest stage of the cognitive hierarchy within the DIKW framework. Although AI systems are capable of processing data, organizing information, and simulating knowledge, the ability to generate wisdom still depends on human reflection, ethical judgment, and independent reasoning. In a digital context, academic wisdom manifests as the student's ability to engage with AI as an "intellectual dialogue partner" without outsourcing their core reasoning. A student possessing academic wisdom uses AI to expand their perspective but maintains full ownership of the synthesis and conclusion. Thus, academic wisdom acts as the ultimate educational outcome, safeguarding the authenticity of human learning against the risk of intellectual atrophy. Innovative teaching approaches such as hypnoteaching have been reported to enhance students' cognitive engagement and motivation in language learning environments, contributing to more reflective and meaningful learning processes [19].

Based on these considerations, this study investigates the influence of multidimensional AI literacy on Academic Wisdom among secondary school students in Indonesia. Specifically, the study examines how technical literacy, critical literacy, and ethical literacy contribute to students' ability to use AI responsibly, reflectively, and ethically in academic contexts. This study contributes theoretically by extending the DIKW framework within AI-mediated learning environments and contributes methodologically by employing SEM analysis to empirically validate the distinct effects of each AI literacy dimension. Practically, the findings provide evidence-based recommendations for curriculum development, AI-integrated pedagogy, and ethical learning practices in secondary education [20].

2. METHOD

2.1. Proposed conceptual model

Based on the literature review and the identified Indonesian AI paradox, we propose an integrative model where ethical literacy mediates the relationship between technical skills and wisdom, while school policy acts as a moderator that strengthens these relationships. Figure 3 illustrates the conceptual framework of AI-driven academic wisdom, visualizing the transformation of raw competencies into intellectual maturity. The model posits that technical literacy and critical literacy act as the independent variables (X), serving as the foundational cognitive resources. However, contrary to linear assumptions, these skills do not directly result in academic wisdom (Y). Instead, the model introduces ethical literacy as a crucial mediating variable (M), functioning as a "moral filter." This structure implies that technical proficiency (how to use AI) and critical analysis (how to verify AI) must first be processed through an ethical lens such as awareness of plagiarism and integrity before they can manifest as true wisdom. Furthermore, the model incorporates school institutional policy (Z) as a moderating variable. Represented by the dashed lines, this variable suggests that the strength of the relationship between literacy and wisdom is contingent upon the educational environment; robust infrastructure and clear regulations significantly strengthen the conversion of student literacy into wise academic behavior.



Independent variables (X): technical literacy, critical literacy
Mediating variable (M): ethical literacy (The "moral filter")
Moderating variable (Z): school institutional policy (infrastructure & regulation)
Dependent variable (Y): academic wisdom

Figure 3. Conceptual model of AI-driven academic wisdom

2.2. Hypothesis formulation

2.2.1. The limited direct effect of technical literacy

While technical mastery is foundational, the DIKW hierarchy suggests that processing data alone does not yield wisdom. Previous studies indicate that without ethical grounding, high technical skill can actually lead to "smart cheating" rather than wisdom. Therefore, technical literacy requires a transformation process. H1: Technical literacy has a positive influence on academic wisdom, but this effect is significantly weaker compared to critical and ethical dimensions.

2.2.2. Ethical literacy as the crucial mediator

Students may possess the skill to prompt an AI (technical), but without the moral compass to decide when and how to use it, wisdom is unattainable. Ethical literacy acts as a "value-added" process, transforming raw technical capability into responsible academic behavior. This confirms the view that ethics is the "gateway" to the top of the DIKW pyramid. H2: Ethical literacy mediates the relationship between technical literacy and academic wisdom, acting as the primary driver of intellectual integrity.

2.2.3. Critical literacy as an antidote to dependence

A major concern in the AI Paradox is the atrophy of thinking skills. "Critical literacy empowers students to question, verify, and challenge algorithmic output (hallucinations), thereby reducing passive reliance." High critical literacy prevents the "delegation of intellectual burden," directly fostering the independence required for academic wisdom. H3: Critical literacy has a significant negative influence on maladaptive AI dependence and a positive influence on academic wisdom.

2.2.4. The moderating role of school policy

The implementation gap in Indonesia (infrastructure deficit vs. high optimism) suggests that individual literacy is not enough. The effectiveness of a student's critical and ethical literacy is contingent upon the supportive environment provided by the school (e.g., clear anti-plagiarism guidelines, AI usage protocols). H4: School institutional policies strengthen (moderate) the positive relationship between AI literacy dimensions and academic wisdom.

2.3. Research methodology

This study adopted a quantitative explanatory design with a cross-sectional survey method to empirically test the proposed conceptual model. The research locus targeted active high school students at SMA Negeri 4 and SMA Negeri 9 Surabaya. These institutions were purposively selected as representatives of urban educational environments characterized by high technology penetration and established digital infrastructure.

As illustrated in Figure 4, the sampling process involved a strict determination of size to satisfy statistical power requirements. The study successfully secured 396 respondents. This sample size was calculated to meet the rigorous criteria for SEM, specifically adhering to the rule of thumb where the sample must be at least 10 times the number of indicators used in the model, ensuring sufficient variability for analysis. Table 2 presents the demographic profile of the respondents, including gender distribution, grade level, and socio-economic background, to enhance the transparency and contextual understanding of the sample characteristics.

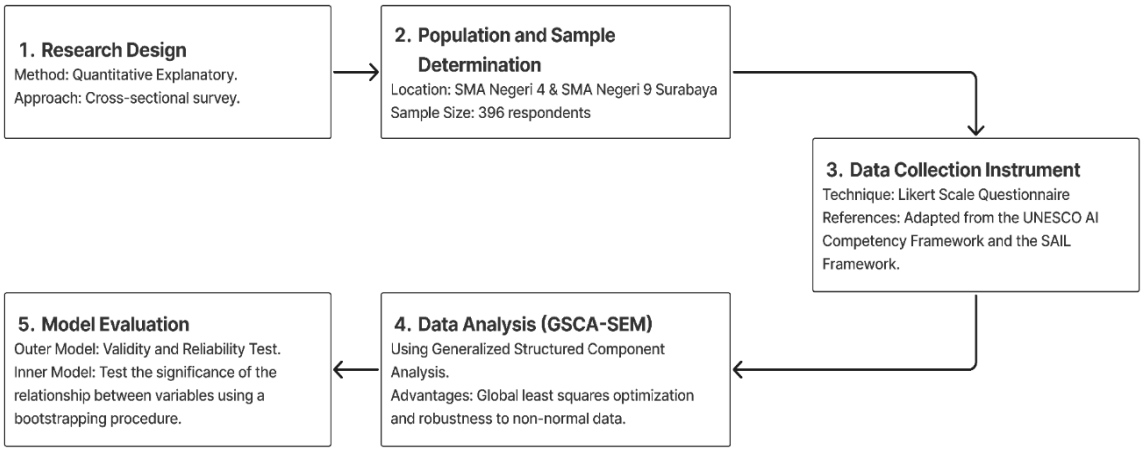


Figure 4. Methodology illustration

Table 2. Respondent demographics

Variable	Category	Frequency	Percentage (%)
Gender	Male	178	44.9
	Female	218	55.1
Grade level	Grade 10	130	32.8
	Grade 11	135	34.1
	Grade 12	131	33.1
Socio-economic background	Low	79	19.9
	Middle	209	52.8
	High	108	27.3

2.4. Data collection and analysis

Data were collected using a structured Likert-scale questionnaire (ranging from 1=strongly disagree to 5=strongly agree). To ensure construct validity and alignment with global standards, the instrument items were adapted from two primary sources:

- The UNESCO AI competency framework, which measures the technical and ethical dimensions of AI usage.
- The social, artificial intelligence, and learning (SAIL) framework, which assesses the critical literacy and cognitive engagement aspects.

2.5. Data analysis: GSCA-SEM approach

The collected data were analyzed using generalized structured component analysis (GSCA-SEM). This method was strategically chosen over covariance-based SEM (CB-SEM) due to its two distinct advantages relevant to educational research:

- Global least squares optimization: it provides a unique global optimization criterion that minimizes the sum of squared residuals for both the measurement and structural models simultaneously.
- Robustness: it is highly robust to non-normally distributed data, which is common in social science surveys.

Mathematically, the GSCA model is defined by specifying the relationship between observed variables and latent components. The measurement model, which links observed variables (z) to their latent constructs γ, is expressed as:

$$Z_i = W_{\gamma i} + e_i \quad (1)$$

Where zi is the vector of standardized observed variables for respondent i, W is the weight matrix of component loadings, γ_i is the vector of latent component scores, and ei is the residual vector.

Meanwhile, the latent structural relationship (inner model) describing the causal paths between literacy and wisdom is expressed as:

$$\gamma_i = B_{\gamma i} + \zeta_i \quad (2)$$

Where B represents the matrix of path coefficients (influence of X on Y) and ζ_i represents the residual vector for the structural model. In this context, γ encompasses the dimensions of AI literacy (independent) and academic wisdom (dependent).

2.6. Model evaluation

The evaluation of the measurement and structural models was conducted using a two-stage assessment procedure. The outer model evaluation assessed convergent validity, discriminant validity, and internal consistency reliability, whereas the inner model evaluation examined the structural relationships among the proposed constructs. Together, these procedures ensured that both the measurement quality and the hypothesized model were statistically robust before hypothesis testing was performed. Specifically, the analysis consisted of two stages:

- Outer model evaluation: to verify the validity (convergent and discriminant) and reliability (internal consistency) of the adapted instrument.
- Inner model evaluation: to test the significance of the hypothesized relationships using a bootstrapping procedure (resampling with replacement), which provides stable standard error estimates even without distributional assumptions.

3. RESULTS AND DISCUSSION

3.1. Evaluation of the measurement model (outer model)

The analysis began by assessing the psychometric properties of the instrument. Rather than reiterating the individual loading values presented in Table 2, the evaluation focuses on validity and reliability trends. The results confirm that the adapted indicators for technical, critical, and ethical literacy meet the convergent validity requirements, with all loading factors exceeding the recommended threshold of 0.70. Similarly, composite reliability scores across all variables surpassed 0.80, indicating high internal consistency. Specifically, indicators KB5 (0.816) and EB1 (0.811) that show very high measurement power. These metrics confirm that the instrument is robust and capable of measuring the multifaceted nature of AI literacy without significant measurement error. As shown in Table 3, all constructs satisfied the recommended thresholds for convergent validity and composite reliability, indicating that the measurement model was appropriate for subsequent structural analysis.

Table 3. Results of the measurement model evaluation (outer model)

Latent construct	Indicator	Estimate (Loading)	SE	Critical ratio (CR)	Conclusion
Technical literacy (TB)	TB1-TB5	0.641-0.776	0.026-0.035	18,067-29,570	Valid
Critical literacy (KB)	KB1-KB5	0.751-0.816	0.024-0.032	23,332-32,551	Valid
Ethical literacy (EB)	EB1-EB5	0.730-0.811	0.025-0.033	22,067-31,954	Valid
Academic policy (AK)	KA1-KA13	0.613-0.723	0.028-0.045	14,288-25,158	Valid

3.2. Evaluation of structural model fit

The overall goodness-of-fit for the proposed model was evaluated using the FIT and adjusted FIT (AFIT) indices provided by the GSCA-SEM analysis. The model yielded a FIT value of 0.439, indicating that the specified model explains approximately 43.9% of the total variance of all variables. While not indicative of a perfect fit, this value represents an acceptable and adequate fit for complex educational behavioral models, where total variance explanation is rarely exhaustive. This confirms that the theoretical framework is empirically supported by the data structure.

Table 4. Model fit index

Fit index	Yield value	Standard criteria	Conclusion
Goodness of fit index (GFI)	0.986	>0.90	Very fit
Std. Root mean square residual (SRMR)	0.041	<0.08	Very fit
FIT	0.439	-	Moderate
Adjusted FIT (AFIT)	0.436	-	Stable

3.3. Hypothesis testing and interpretation

The structural model testing was conducted to validate the four proposed hypotheses. As visualized in the path diagram as shown in Figure 4, the relationships between variables demonstrate varying degrees of significance:

– H1: Technical literacy as a minor contributor

The analysis shows that technical literacy has a positive influence on academic wisdom, but with a relatively low path coefficient (β=0.170). This finding supports H1, interpreting that technical mastery while foundational is the least influential driver of wisdom. It suggests that knowing "how to use" AI tools is insufficient for cultivating deep academic integrity without the support of higher-order thinking skills. The present finding is consistent with international empirical studies showing that technical literacy enhances students' ability to use AI effectively by improving their understanding of AI capabilities and limitations. However, previous studies also indicate that technical competence alone is insufficient to ensure responsible AI use without adequate critical and ethical competencies. In the Indonesian context, differences in digital literacy readiness and educational infrastructure may explain why technical literacy contributes less strongly to academic wisdom than higher-order cognitive and ethical competencies.

– H2: Critical literacy as a cognitive filter

Critical literacy demonstrated a significant positive impact (β=0.322). This supports H3, suggesting that students who actively verify algorithmic outputs and question bias are less likely to fall into passive dependence. The strength of this coefficient highlights critical thinking as a necessary defense mechanism against AI hallucinations. This finding is consistent with international studies reporting that critical literacy enables students to evaluate AI-generated information, identify misinformation, and make informed academic decisions. These results confirm that critical literacy functions as an essential cognitive filter in AI-assisted learning. In Indonesia, unequal digital readiness may further increase students' reliance on AI-generated content, making critical literacy particularly important for maintaining independent reasoning.

– H3: The mediating role of ethical literacy

Consistent with the "moral filter" concept in the conceptual model, ethical literacy emerged as the strongest predictor of academic wisdom (β=0.354). This validates H2, indicating that students' ability to navigate issues like plagiarism and intellectual property is the primary determinant of wise behavior. Ethical literacy effectively bridges the gap between raw technical skill and academic integrity. The dominant role of ethical literacy is consistent with international studies showing that ethical awareness is the primary driver of responsible AI use in education. Previous research has emphasized that academic integrity, transparency, and accountability are more influential than technical competence in promoting responsible AI adoption. Given the rapid growth of AI use and uneven institutional guidance in Indonesia, ethical literacy becomes increasingly important for preventing academic misconduct and fostering responsible AI-assisted learning.

Overall, the findings are broadly consistent with international evidence demonstrating that responsible AI integration depends on the balanced development of technical, critical, and ethical competencies. Nevertheless, Indonesia's unequal digital readiness and educational infrastructure may explain the stronger influence of ethical literacy observed in this study. These findings contribute to the international literature by providing empirical evidence from a developing-country context and highlighting the need for context-sensitive AI education policies.

As shown in Table 5, all proposed relationships between AI literacy dimensions and academic wisdom were statistically significant.

Table 5. Hypothesis testing results (inner model)

Hypothesis	Relationship Path	Estimate (β)	SE	Critical ratio (CR)	Conclusion
H1	Technical literacy (TB) → Academic policy (KA)	0.170	0.054	3,142	Accepted
H2	Critical literacy (KB) → Academic policy (KA)	0.322	0.061	5,304	Accepted
H3	Ethical literacy (EB) → Academic wisdom (KA)	0.354	0.063	5,612	Accepted

Based on the results of the analysis, the structural equations of this study are:

$$KA = 0.170(TB) + 0.322(KB) + 0.354(EB) + \zeta$$

This model, as shown in Table 4, successfully explained 43.9% of the variance in students' academic wisdom (FIT=0.439). This indicates that the AI literacy dimensions tested in this study are moderate and representative predictors in explaining students' academic behavior in the era of disruption [21].

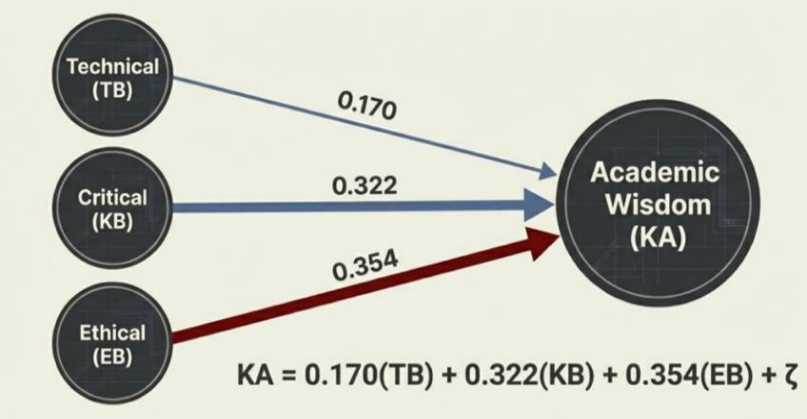


Figure 4. Our hypothesis: proposed conceptual model

3.4. Variance explained (R2)

Overall, the model explains 43.9% of the variance in academic wisdom (R2=0.439). This explanatory power is categorized as moderate. While substantial, it indicates that over half of the variance in students' academic wisdom is influenced by factors outside the scope of this study, such as parental guidance, intrinsic motivation, or peer influence. Therefore, while AI literacy is a critical component, it is not the sole determinant of student wisdom in the digital age.

3.5. The dominance of ethical literacy in addressing academic wisdom

The most crucial finding from the structural model is the dominance of ethical literacy (EB) as the largest contributor to academic wisdom (β=0.354). This empirical evidence directly addresses the "implementation gap" identified in the literature, where the Indonesian education sector faces a dichotomy between rapid adoption and low readiness. Specifically, the data suggests that students' extremely high optimism toward AI (80%) must be counterbalanced with strong moral fortifications to prevent misuse. This finding aligns with the DIKW hierarchy framework, which posits that while AI can process data and information, true wisdom is exclusively achieved through human ethical considerations and value judgments that algorithms lack. Consequently, ethical literacy serves not just as a variable, but as the primary "gateway" to wisdom in the digital age.

Figure 5 highlights the alarming disparity between enthusiasm for AI use and foundational literacy. The data reveals that while 80% of Indonesian students express optimism regarding AI benefits far exceeding the global average of 36-54% this enthusiasm is not accompanied by adequate critical understanding. The graph further illustrates significant structural obstacles, specifically an 85% deficit in IT infrastructure readiness and Indonesia's PISA literacy scores (359-383), which lag nearly 100 points behind the global average of 472-476. This statistical reality creates a high-risk environment where students may rush to adopt generative AI tools like ChatGPT without the necessary "critical defense mechanisms" to evaluate algorithmic output.

The dominance of ethical aspects (β=0.354) demonstrates that students who understand the risks of AI-based plagiarism and the importance of intellectual integrity tend to exhibit higher levels of academic

wisdom. This reinforces the proposition that technology navigation at the secondary school level must emphasize character education rather than mere technical training. These findings are also consistent with recent international studies emphasizing that ethical and critical competencies play a more decisive role than technical proficiency in responsible AI integration. Studies conducted in European and East Asian educational contexts similarly report that students with higher ethical awareness demonstrate stronger resistance to automation bias and greater academic autonomy. This suggests that the challenges identified in the Indonesian context reflect broader global concerns regarding the balance between AI adoption and human intellectual agency.

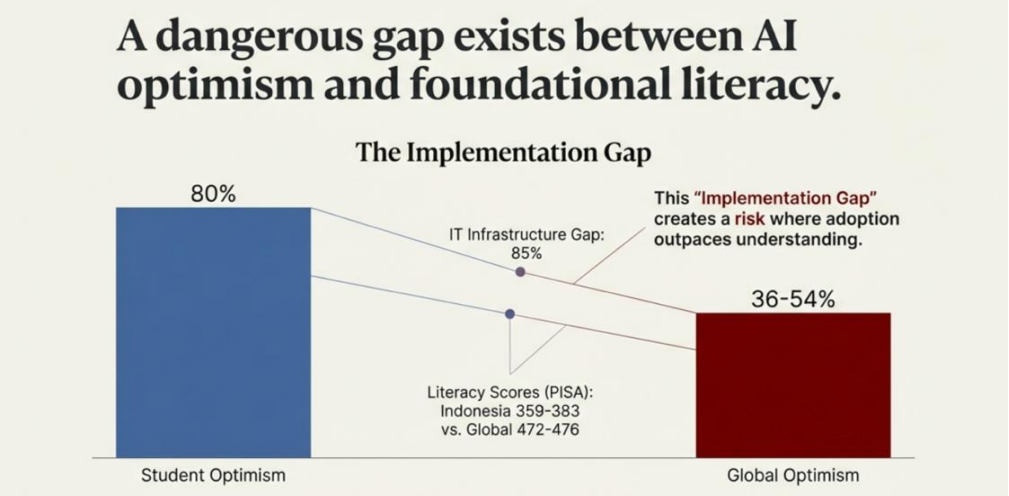


Figure 5. A dangerous gap exists between AI optimism and foundational literacy

3.6. Critical literacy as a filter for maladaptive dependencies

In accordance with H4 proposed in the theoretical framework, critical literacy (CFL) plays a significant role (β=0.322) in shaping students' wisdom. Statistically, this variable functions as a cognitive "filter" that empowers students to verify validity, recognize bias, and detect "hallucinations" often produced by generative AI systems [6]. This finding provides empirical support for the recommendations derived from the PISA 2022 results, highlighting the urgent need to strengthen critical reasoning skills to prevent students from falling into the trap of passively accepting algorithmic information as absolute truth [11], [22].

3.7. Limitations of technical literacy and policy implications

Interestingly, the structural analysis reveals that technical literacy (TC) had the lowest impact on academic wisdom (β=0.170). This finding aligns with recent policy reviews indicating that technical instructions on "how to use" AI prompts or software are insufficient to ensure academic integrity [23]–[25]. These results imply that secondary schools in Surabaya should not focus solely on narrowing the 85% IT infrastructure gap mentioned in the introduction. Instead, the priority should shift toward curricula that integrate informed evaluation and moral responsibility. Practically, these findings provide a basis for educators to design "smart assessment" methods that minimize reliance on AI for output generation, focusing instead on the process of reasoning, as recommended in academic integrity best practices [26]–[28].

Figure 6 visualizes about the core argument summarization about that academic wisdom emphasizes the strategic repositioning of humans at the top of the DIKW pyramid. The conceptual model demonstrates that while AI dominates processing efficiency at the data, information, and knowledge levels, the human domain exclusively controls wisdom through intuition and ethics [29]–[31]. The path analysis confirms that technical proficiency (β=0.170) is the weakest driver, falling far behind ethical literacy (β=0.354). This disparity demands a paradigm shift in educational policy: AI must be positioned strictly as a "dialogue partner" rather than a substitute for reasoning, acknowledging that algorithms lack the spiritual experience and contextual ethical judgment essential for wise decision-making [32]–[35]. These findings highlight a critical misalignment between current educational practices and the competencies required for responsible AI use. Without rebalancing this focus, increased AI adoption may unintentionally undermine the development of independent thinking and academic integrity.

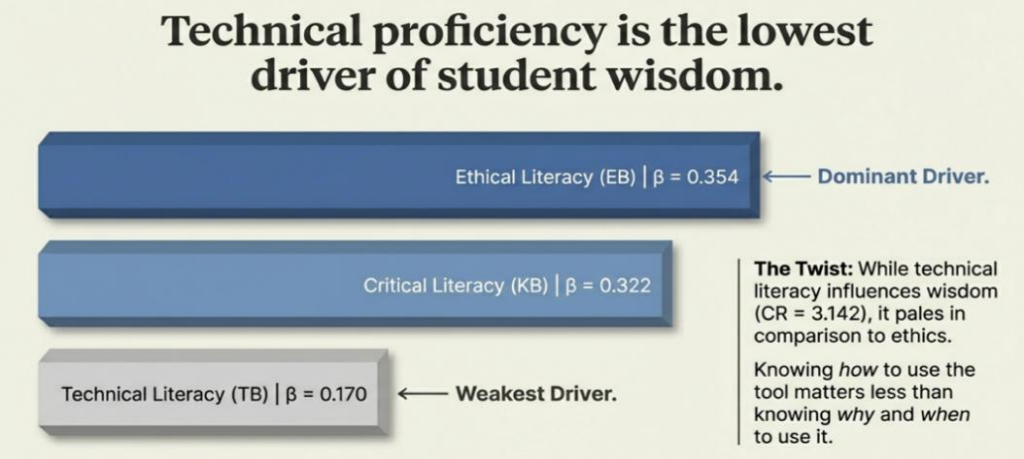


Figure 6. Technical proficiency is the lowest driver of student wisdom

4. CONCLUSION

This study concludes that multidimensional AI literacy significantly influences students' academic wisdom, with ethical literacy emerging as the most dominant factor, followed by critical and technical literacy. The findings demonstrate that academic wisdom is not primarily driven by technological proficiency, but by students' ability to critically evaluate and ethically regulate AI use, positioning AI as a dialogue partner rather than a substitute for reasoning. The study extends the DIKW framework by empirically confirming that ethical literacy functions as a key mechanism in transforming knowledge into wisdom in AI-mediated learning environments, while critical literacy serves as a cognitive safeguard against unreflective dependence on algorithmic outputs. These results highlight a necessary shift in educational practice from a purely technical focus toward the integration of ethical and critical competencies, including curriculum reorientation, pedagogical transformation, and assessment redesign that prioritizes reasoning processes over output. However, this study is limited to a specific urban context and relies on self-reported data, which may affect generalizability. Future research should incorporate more diverse samples and longitudinal approaches to better understand the evolving role of AI literacy in shaping academic behavior.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
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E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [RRPA], upon reasonable request.

REFERENCES

[1] P. Jayavardhini, R. M. Mahalakame, P. Srinivetha, and I. E. Berna, "AI study partner: development of an LLM and Gen AI-enhanced study assistant tool," *International Journal of Scientific Research in Engineering and Management*, vol. 8, no. 3, pp. 1–5, 2024, doi: 10.55041/IJSREM29626.

[2] M. M. Rahman and Y. Watanobe, "ChatGPT for education and research: Opportunities, threats, and strategies," *Applied Sciences*, vol. 13, no. 9, p. 5783, 2023, doi: 10.3390/app13095783.

[3] C. Faizah, S. Sabrina, and N. M. Ismail, "Phonological Shift among Generation Z: The Impact of Social Media on Acehnese Accents in Coastal Areas," *International Journal of Education, Language, and Religion*, vol. 7, no. 2, pp. 231–242, 2025, doi: 10.35308/ijelr.v7i2.13383.

[4] I. Suyitno, A. Fawzi, and H. D. Arista, "Language attitudes of Generation Z in responding to teacher questions in learning interactions," in *CoDAS*, 2025, vol. 37, no. 5, p. e20250098, doi: 10.1590/2317-1782/e20250098en.

[5] G. Susanto, D. Pickus, D. Espree-Conaway, Suparmi, A. Rusiandi, and H. Noviya, "Indonesian language policy and perspectives on its implementation in promoting Bahasa Indonesia as an international language," *Cogent Arts & Humanities*, vol. 11, no. 1, p. 2364511, 2024, doi: 10.1080/23311983.2024.2364511.

[6] A. Herviana, "Artificial Intelligence in Education: Opportunities and Challenges of AI Integration in Indonesian Classrooms," *Journal of Smart Pedagogy and Education*, vol. 1, no. 1, pp. 34–45, 2025, doi: 10.65101/spedu.v1i1.22.

[7] IPSOS, "Ipsos Education Monitor 2025: A 30-Country Ipsos Global Advisor Survey," 2025.

[8] UNESCO, "AI and education Protecting the rights of learners," UNESCO, 2025.

[9] Microsoft Corporate Blogs, "Global AI Adoption in 2025—A widening digital divide," Microsoft, pp. 1–18, Jan. 2026, [Online]. Available: https://blogs.microsoft.com/on-the-issues/2026/01/08/global-ai-adoption-in-2025.

[10] Indonesia Internet Service Provider Association (APJII), "Internet Indonesia," *Survei Penetrasi Internet Indonesia*, pp. 1–90, 2024, [Online]. Available: https://survei.apjii.or.id/survei/2024

[11] OECD, *PISA 2022 Results (Volume III): Creative Minds, Creative Schools Factsheets – Indonesia*, 1st ed. Paris: OECD Publishing, 2024, doi: 10.1787/53f23881-en.

[12] L. Fesler, J. P. M. Claeys, C. Agnew, and S. Loeb, "The Evidence Base on AI in K-12: A 2026 Review," SCALE Initiative Stanford, 2026.

[13] D. Kim, Q. Zhu, and H. Eldardiry, "Toward a policy approach to normative artificial intelligence governance: Implications for AI Ethics Education," *IEEE Transactions on Technology and Society*, vol. 5, no. 3, p. 325, 2024, doi: 10.1109/TTS.2024.3430940.

[14] H. Chee, S. Ahn, and J. Lee, "A competency framework for AI literacy: Variations by different learner groups and an implied learning pathway," *British Journal of Educational Technology*, vol. 56, no. 5, pp. 2146–2182, 2025, doi: 10.1111/bjet.13556.

[15] N. Goyibova, N. Muslimov, G. Sabirova, N. Kadirova, and B. Samatova, "Differentiation approach in education: Tailoring instruction for diverse learner needs," *MethodsX*, vol. 14, p. 103163, 2025, doi: 10.1016/j.mex.2025.103163.

[16] M. A. Peters and B. J. Green, "Wisdom in the Age of AI Education," *Postdigital Science and Education*, vol. 6, no. 4, pp. 1173–1195, 2024, doi: 10.1007/s42438-024-00460-w.

[17] D. Long and B. Magerko, "What is AI literacy? Competencies and design considerations," in *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 2020, pp. 1–16, doi: 10.1145/3313831.3376727.

[18] D. T. K. Ng, J. K. L. Leung, S. K. W. Chu, and M. S. Qiao, "Conceptualizing AI literacy: An exploratory review," *Computers and Education: Artificial Intelligence*, vol. 2, p. 100041, 2021, doi: 10.1016/j.caeai.2021.100041.

[19] K. MacCallum, D. Parsons, and M. Mohaghegh, "The Scaffolded AI Literacy (SAIL) Framework for Education: Preparing learners at all levels to engage constructively with Artificial Intelligence," *He Rourou*, vol. 1, no. 1, p. 23, 2024, doi: 10.54474/herourou.v1i1.10835.

[20] D. Widyartono, I. A. Basuki, and L. Ivana, "Implementation of hypnoteaching principles in learning Indonesian text writing Merdeka curriculum: Literature review," *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, Dan Pengajarannya*, vol. 11, no. 1, pp. 247–262, 2025, doi: 10.22219/kembara.v11i1.36080.

[21] H. Hwang and Y. Takane, *Generalized Structured Component Analysis: A Component-Based Approach to Structural Equation Modeling*, 1st ed. Chapman and Hall/CRC, 2014, doi: 10.1201/b17872.

[22] G. Cho, H. Hwang, M. Sarstedt, and C. M. Ringle, "Cutoff criteria for overall model fit indexes in generalized structured component analysis," *Journal of Marketing Analytics*, vol. 8, no. 4, pp. 189–202, 2020, doi: 10.1057/s41270-020-00089-1.

[23] E. la Ramírez-Baraldes, D. García-Gutiérrez, and C. García-Salido, "Artificial intelligence in nursing: New opportunities and challenges," *European Journal of Education*, vol. 60, no. 1, p. e70033, 2025, doi: 10.1111/ejed.70033.

[24] J. Cai, "Analysis of the impact of AI on modern education: Inside and outside the classroom," *Journal of Computer Science and Technology Studies*, vol. 6, no. 4, pp. 25–31, 2024, doi: 10.32996/jcsts.2024.6.4.4.

[25] T. Lintner, "A systematic review of AI literacy scales," *npj Science of Learning*, vol. 9, no. 1, p. 50, 2024, doi: 10.1038/s41539-024-00264-4.

[26] M. J. Koch, C. Wienrich, S. Straka, M. E. Latoschik, and A. Carolus, "Overview and confirmatory and exploratory factor analysis of AI literacy scale," *Computers and Education: Artificial Intelligence*, vol. 7, p. 100310, 2024, doi: 10.1016/j.caeai.2024.100310.

[27] E. Auld, L. Xiaomin, and P. Morris, "Piloting PISA for development to success: an analysis of its findings, framework and recommendations," *Compare: A Journal of Comparative and International Education*, vol. 52, no. 7, pp. 1145–1169, 2022, doi: 10.1080/03057925.2020.1852914.
[28] B. Barbot and J. C. Kaufman, "PISA 2022 creative thinking assessment: Opportunities, challenges, and cautions," *Journal of Creative Behavior*, vol. 59, no. 1, p. e70003, 2025, doi: 10.1002/jocb.70003.
[29] L. Meng and X. Huang, "Reimagining Education Through IoT: Assessing the Pedagogical and Ethical Impacts of Smart Assessment Systems," *International Journal of Human–Computer Interaction*, vol. 42, no. 20, pp. 17555–17576, 2026, doi: 10.1080/10447318.2026.2626813.
[30] Z. Wang, "AI-Assisted research on intelligent evaluation system for preschool education," *Australian Journal of Electrical and Electronics Engineering*, pp. 1–13, 2025, doi: 10.1080/1448837X.2025.2482335.
[31] S. Akinwalere and K. Chang, "The symbiotic roles of artificial intelligence and human intelligence in advancing knowledge ecosystem," *Journal of Knowledge Management*, pp. 1–42, 2026, doi: 10.1108/JKM-03-2025-0362.
[32] M. Graves, "Apprehending AI moral purpose in practical wisdom," *AI & Society*, vol. 39, no. 3, pp. 1335–1348, 2024, doi: 10.1007/s00146-022-01597-7.
[33] R. Raman, R. Kowalski, K. Achuthan, A. Iyer, and P. Nedungadi, "Navigating artificial general intelligence development: societal, technological, ethical, and brain-inspired pathways," *Scientific Reports*, vol. 15, no. 1, p. 8443, 2025, doi: 10.1038/s41598-025-92190-7.
[34] R. Wegerif and I. Casebourne, "A dialogic theoretical foundation for integrating generative AI into pedagogical design," *British Journal of Educational Technology*, vol. 57, no. 3, pp. 639–654, 2026, doi: 10.1111/bjet.70026.
[35] Y.-B. Zheng, Y.-X. Zhou, X.-D. Chen, and X.-D. Ye, "The influence of large language models as collaborative dialogue partners on EFL English oral proficiency and foreign language anxiety," *Computer Assisted Language Learning*, vol. 39, no. 4, pp. 1092–1118, 2026, doi: 10.1080/09588221.2025.2453191.

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