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Breaking the "Non-Exact Sciences" Myth: Disciplinary Sensitivity and AI Ethical Awareness Among Pre-Service Language Teachers

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ABSTRACT

The rapid integration of Generative Artificial Intelligence (GenAI) in higher education has sparked global concerns regarding academic integrity and regulation. However, existing literature often generalizes student perceptions through a binary STEM versus non-STEM lens, obscuring crucial intradisciplinary variations. This study investigated the disparities in ethical awareness and regulatory demands regarding GenAI among university students, specifically challenging the monolithic categorization of Non-Exact Sciences. Employing a quantitative cross-sectional survey, data from 721 Indonesian undergraduates were collected using a 25-item Likert-scale questionnaire, validated via Pearson correlation with high reliability (Cronbach's α = 0.957). Statistical analysis using the Kruskal-Wallis H test revealed a significant divergence from traditional assumptions. While macro-analysis confirmed Exact Science students generally exhibit higher ethical awareness, granular post-hoc analysis uncovered Language Education students represent a positive anomaly. These findings empirically operationalize the concept of 'epistemological proximity,' the degree to which GenAI intersects with a discipline's core ontology, such as text production in language studies. As a measurable predictor of AI ethical awareness, students in text-centric disciplines (Language Education) demonstrated significantly higher ethical (Mean Rank = 419.64) and regulatory demand scores (Mean Rank = 403.17) compared to other Non-Exact Sciences (p < .001), rendering their profiles statistically indistinguishable from Exact Sciences. Thus, epistemological proximity is a stronger and more operational predictor of ethical awareness than broad binary disciplinary labels. The study concludes that the non-exact sciences category is no longer relevant for AI adoption studies and recommending policymakers develop discipline-sensitive AI literacy programs addressing the specific regulatory vacuums.

Keywords: Artificial Intelligence; Disciplinary Sensitivity; Epistemological Proximity; AI Ethics; Pre-service Language Teachers.

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1. INTRODUCTION

The integration of GenAI into higher education has catalysed a paradigm shift in language pedagogy, particularly within English as a Foreign Language (EFL) context. A recent systematic review by Li et al. (2024) confirms that empirical research on tools like ChatGPT has surged globally, focusing on their roles as digital tutors and automated feedback providers. However, this technological disruption demands more than just adoption; it requires a redefinition of professional competence. While recent research within the Indonesian context confirms that pre-service teachers of the Z-generation possess a strong foundation in digital literacy and self-belief regarding educational technology (Jaya, 2024), the disruption caused by Generative AI demands capabilities that extend beyond mere technical proficiency. Moorhouse et al. (2024) argue that language teachers often lack the critical abilities to leverage these tools effectively, necessitating explicit training to enhance their professional GenAI competence. Furthermore, as highlighted by Lee et al. (2025), pre-service teachers are not passive users but active agents who negotiate their collaboration with AI to balance pedagogical benefits with responsible usage.

Despite its promise, the adoption of GenAI creates a landscape that is both promising and perilous, often described as a double-edged sword (Derakhshan & Ghiasvand, 2024). While GenAI can augment learner autonomy, it simultaneously introduces unprecedented challenges regarding academic integrity (Sevryugina & Li, 2026). Cong-Lem et al. (2024) and (Castillo-Cuesta, 2025) warn that over-reliance on AI may hinder the development of critical thinking, attributing AI-driven plagiarism to students' poor learning attitudes. However, a critical systemic problem remains: the rapid pace of AI adoption often outpaces the formulation of clear institutional rules, creating a 'policy vacuum' (Hollander et al., 2026). This regulatory lag leads to what Smit et al. (2025) describes as 'moral hazards', where even well-intentioned students may slide into misconduct due to the lack of explicit guidance regarding the 'grey areas' of collaboration versus collusion (Pike et al., 2025).

Ideally, policy should precede practice, yet existing literature predominantly addresses this challenge through a highly generalized lens. Recent systematic reviews and empirical studies indicate that studies typically rely on binary distinctions, comparing STEM (Science, Technology, Engineering, and Mathematics) with non-STEM disciplines (Saihi et al., 2025; Tan, 2025; Ursavaş et al., 2025). For instance, Kubullek et al. (2024) highlighted higher adoption among STEM students compared to Business students, yet such bimodal classification fails to account for the crucial 'intradisciplinary variability' within the broad non-STEM category. As argued by Qu (2024); Wang et al. (2025) disciplines are not merely administrative labels but distinct academic communities with specific cultures, values, and epistemologies that dictate how validity, integrity, and technological adoption are perceived.

The generalized "non-STEM" label obscures the unique position of specialized disciplines like Language Education, where the core content of study (textual integrity and syntactical originality) is directly intersected by the text-generating capabilities of Large Language Models (LLMs). According to recent studies on disciplinary differences Alghamdi (2025); Wang et al. (2025), "soft-applied" disciplines like education place a premium on interpretation and the integrity of the written word, distinguishing them significantly from "hard-pure" sciences where text is often merely a vehicle for reporting data (Eddine et al., 2025). Consequently, a significant theoretical and empirical gap exists regarding how pre-service teachers from text-based disciplines perceive AI's ethical impact compared to their peers in STEM (Khasawneh, 2024). While Castillo-Cuesta (2025); Karaduman (2025) noted pre-service teachers' concerns regarding overdependence and perceived AI competency, there is a lack of granular evidence demonstrating how this disciplinary sensitivity modulates ethical awareness and regulatory demand.

Addressing these gaps, this study moves beyond the monolithic binary of Exact Sciences versus Non-Exact Sciences. Drawing on the theoretical frameworks of disciplinary differences and recent findings on AI anxiety and acceptance, this research aimed to: (1) analyze the differential perception of AI ethics and regulation between students from Exact Sciences, Language Education, and other Non-Exact Sciences disciplines; and (2) identify specific ethical and regulatory items that contribute to disciplinary variance. The findings are expected to challenge the prevailing binary narrative and offer actionable insights for developing "Disciplinary-Sensitive" AI literacy programs.

2. METHODS

This study adopted a cross-sectional quantitative survey design with a descriptive-exploratory purpose. This design was selected to enable the measurement of AI ethics and regulatory perceptions across a diverse student population at a single point in time, consistent with recent findings highlighting disciplinary background as a key determinant of GenAI engagement (Qu, 2024). The approach utilized a large-scale survey followed by sequential non-parametric statistical analyses to investigate cross-disciplinary disparities regarding GenAI in Indonesian higher education. The comprehensive research procedure is illustrated in Figure 1.

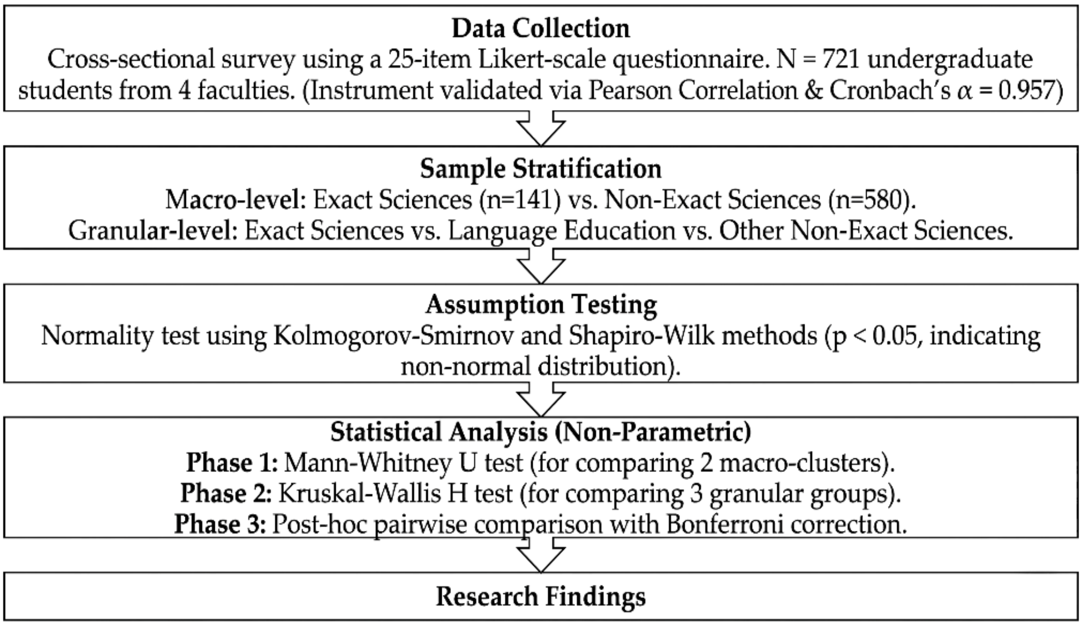

Figure 1. Flowchart of the Research Process

Grounding the analysis in recent evidence that academic discipline significantly moderates AI adoption behaviors (Saihi et al., 2025), data collection (N=721) employed a 25-item Likert-scale questionnaire specifically designed to assess two primary constructs: Total Ethics (M=36.455, SD=8.4798) and Total Regulation (M=28.459, SD=6.4881). To ensure construct validity, these constructs were operationalized into specific observable dimensions. The 'Ethical Awareness' construct evaluates dimensions such as Technical Literacy (e.g., sample items: Awareness of AI Plagiarism and Comprehension of AI Technical Limitations) and Philosophical Perceptions (e.g., Perceived Erosion of Critical Thinking). Conversely, the 'Regulatory Demand' construct measures institutional governance, focusing on Clarity of Guidelines (e.g., sample items: Perception of Current Rules as Ambiguous and Demand for Practical Guidelines). The psychometric properties of the instrument were rigorously validated; item validity was established through Pearson Product-Moment Correlation analysis, which demonstrated that all items exhibited significant positive correlations with the total score. Furthermore, the instrument demonstrated exceptional

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Data were analyzed sequentially using SPSS Version 27, Fiandini & al. (2024) with a significance level of α = 0.05. Preliminary assumption testing via Kolmogorov-Smirnov and Shapiro-Wilk indicated that all variables significantly deviated from normality (p < 0.05). Methodologically, the reliance on non-parametric statistics is justified not only by this non-normal distribution but also by the inherent ordinal nature of the Likert-scale data, rendering non-parametric rank-based tests the most robust analytical choice. Consequently, the independent-samples Mann-Whitney U test was employed for macro-level comparisons between Exact and Non-Exact clusters. To address the study's granular objectives, the Kruskal-Wallis H test was utilized to compare the Exact Sciences, Language Education, and Other Non-Exact Sciences groups. The results confirmed significant disparities for Total Ethics (H = 61.644, p < 0.001) and Total Regulation (H = 43.521, p < 0.001), prompting a post-hoc analysis. Crucially, a Bonferroni correction was applied during these multiple pairwise comparisons. This strict error control procedure is methodologically required to constrain the Family-Wise Error Rate (Type I error inflation), thereby ensuring that the empirical validation of the "Language Education Anomaly" is statistically rigorous and protected against false-positive discoveries.

3. RESULT AND DISCUSSION

This section presents the statistical findings and a comprehensive discussion regarding the disparities in ethical perceptions and regulatory demands concerning GenAI among university students. The results are presented sequentially, progressing from a macro-level analysis to a granular examination, and are subsequently discussed by ssynthesizing with the findings of existing literature to highlight the specific novelty of this study.

3.1 Result

Before analysing the differences between the two groups using statistical tests, a normality test was first conducted to determine whether the data were normally distributed or not. This normality test is important so that the type of statistical test (parametric or non-parametric) can be adjusted to the characteristics of the data. The results of the normality test using the Kolmogorov–Smirnov and Shapiro–Wilk methods showed that all research variables, namely Total_Ethics and Total_Regulations, in both study programme clusters (Exact and Non-Exact) had a significance value of < 0.05. Thus, it can be concluded that the data was not normally distributed, as shown in Table 1.

Table 1. Tests of Normality

	Disciplinary Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	$Sig.$	Statistic	df	$Sig.$
Total Ethics	Exact Sciences	.131	141	.000	.925	141	.000
	Non-Exact Sciences	.129	580	.000	.940	580	.000
Total Regulation	Exact Sciences	.105	141	.001	.934	141	.000
	Non-Exact Sciences	.156	580	.000	.938	580	.000

Note. df = degrees of freedom. [a] Lilliefors Significance Correction

Specifically, the results indicated that Total Ethics scores significantly deviated from normality for both the Exact Sciences (p < .001) and Non-Exact Sciences (p < .001) groups. A similar pattern was observed for Total Regulation (Exact: p = .001; Non-Exact: p < .001). As all significance values fell below the conventional threshold (α = .05), the assumption of normality was untenable. Since the data is not normally distributed, parametric tests such as the independent t-test cannot be used. As an alternative, a non-parametric test is used to compare two independent groups, namely the Mann-Whitney U test. The results of the test are presented in the following Table 2.

Table 2. Mann-Whitney U Test Results Comparing Ethics and Regulation Scores between Disciplinary Clusters

Variable	Disciplinary Group	N	Mean Rank	Mann-Whitney U	Z	p
Total Ethics	Exact Sciences	141	402.69	35,012.000	-2.665	.008
	Non-Exact Sciences	580	350.87			
Total Regulation	Exact Sciences	141	409.72	34,021.000	-3.120	.002
	Non-Exact Sciences	580	349.16			

Note. N = number of participants; p = asymptotic significance (2-tailed).

A Mann–Whitney U test revealed a significant difference in Total Ethics scores between the Exact Sciences and Non-Exact Sciences groups (U = 35,012.00, Z = -2.67, p = .008). However, calculating the effect size reveals a relatively small magnitude of difference ($r = 0.10$). A similar pattern was observed for Total Regulation, with a significant disparity emerging between the two clusters (U = 34,021.00, Z = -3.12, p = .002) but also yielding a small effect size ($r = 0.12$). Analytically, while these macro-level findings indicate that Exact Sciences students generally possess higher ethical awareness and regulatory demand, the small effect sizes suggest that a binary disciplinary categorization (STEM vs. non-STEM) only partially explains the variance. This statistical limitation justifies the need for a more granular, item-level disaggregation to identify the true friction points, as shown in Table 3.

Table 3. Presentation of the Comprehensive Item-By-Item Comparison of AI Ethics and Regulation Perceptions Across Disciplines

Variable/Item	Disciplinary Group	*N*	Mean Rank	*z*	*p*
Regulatory Demand (Clarity of Guidelines)					
Perception of Current Rules as "Ambiguous" (Reg4)	Exact Sciences	141	438.33	-5.188	<.001*
	Non-Exact Sciences	580	342.20		
Demand for Practical Guidelines (Reg5)	Exact Sciences	141	404.15	-2.909	.004*
	Non-Exact Sciences	580	350.51		
Agreement on the Need for Guidelines (Reg3)	Exact Sciences	141	401.60	-2.712	.007*
	Non-Exact Sciences	580	351.13		
Ethical Awareness (Technical Literacy)					
Knowledge of External Regulations (Eth4)	Exact Sciences	141	405.32	-2.957	.003*
	Non-Exact Sciences	580	350.23		
Awareness of AI Plagiarism (Eth1)	Exact Sciences	141	398.45	-2.499	.012*
	Non-Exact Sciences	580	351.90		
Comprehension of AI Technical Limitations (Eth10)	Exact Sciences	141	394.60	-2.233	.026*
	Non-Exact Sciences	580	352.83		
Areas of Convergence (Philosophical & Institutional Perceptions)					
Perceived Erosion of Critical Thinking (Eth7)	Exact Sciences	141	386.48	-1.695	.090
	Non-Exact Sciences	580	354.81		
Reception of Institutional Information (Eth5)	Exact Sciences	141	389.43	-1.900	.057
	Non-Exact Sciences	580	354.09		

Note. Data analysis performed using SPSS version 27 (Mann–Whitney U non-parametric test).

Rather than redundantly reiterating the statistical values detailed in Table 3, a synthesized evaluation of the item-level analysis reveals three distinct friction points driving the disciplinary divide. *First*, the regulatory divergence is profoundly driven by Exact Sciences students' acute sensitivity to institutional ambiguity (Reg4) and their practical demand for clear guidelines (Reg5). *Second*, the ethical gap is heavily characterized by technical literacy; Exact Sciences students exhibit superior awareness of AI technical limitations (Eth10) and AI-driven plagiarism (Eth1). *Third*, despite these differences, both clusters share statistical homogeneity regarding philosophical concerns, such as the perceived erosion of critical thinking (Eth7), indicating that abstract academic anxieties are universally shared regardless of discipline.

Recognizing that technical literacy and sensitivity to regulatory ambiguity are the primary drivers of the Exact vs. Non-Exact divide, it is imperative to investigate whether these traits are uniform across all 'soft' sciences. The 'Non-Exact Sciences' cluster encompasses diverse disciplines, such as Language Education, which inherently relies on text production (a core function of GenAI). To test this epistemological proximity, the Kruskal-Wallis H test was employed across three refined clusters (Table 4).

Table 4. Results of the Kruskal-Wallis H Test for Differences in Perceptions of AI Ethics and Regulation Based on Academic Discipline

Variable	Kelompok	N	Mean Rank	H	df	p
Total_Ethics	Other Non-Exact Sciences	439	292.20	61.64	2	< .001
	Language Education	141	419.64			
	Exact Sciences	141	402.69			
Total_ Regulation	Other Non-Exact Sciences	439	303.08	43.52	2	< .001
	Language Education	141	403.17			
	Exact Sciences	141	409.72			

The tripartite analysis unveiled distributional patterns that fundamentally reshape the prevailing binary narrative. The test revealed highly significant differences for Total Ethics (H = 61.64, p < .001) and Total Regulation (H = 43.52, p < .001). Crucially, the effect sizes (epsilon-squared, ε^2) for these granular analyses were moderate (ε^2= 0.086 for Ethics, and ε^2= 0.060 for Regulation), demonstrating a stronger explanatory power than the binary macro-model. Post-hoc pairwise comparisons with Bonferroni correction empirically validated the 'Language Education Anomaly.' Specifically, Language Education students not only significantly outperformed the Other Non-Exact Disciplines (p < .001), but their ethical and regulatory mean ranks (419.64 and 403.17, respectively) formed a statistically homogeneous subset with the Exact Sciences (p = 1.000). Synthesizing this with the item-level findings, the anomaly proves that students in text-centric disciplines possess the same acute vigilance toward AI plagiarism and regulatory voids as their STEM counterparts, completely decoupling them from the monolithic assumption of the 'Non-Exact' category.

3.2 Discussion

This study provides a critical correction to the prevailing technology adoption literature, which has historically relied on broad binary classifications. By isolating Language Education from the generic 'Non-Exact Sciences' category, this research uncovers a significant 'Disciplinary Anomaly' that challenges the assumption that STEM students (Exact Sciences) are the exclusive custodians of digital and ethical literacy. The following sections discuss the mechanisms behind these findings by synthesizing the results with contemporary theories of disciplinary culture and technology acceptance.

a. Challenging the Binary: The "Language Anomaly"

Initially, macro-level findings suggested that Exact Science students possess higher ethical awareness than their Non-Exact Sciences peers, a result consistent with prior studies highlighting STEM's dominance in technology adoption (Kubullek et al., 2024; Saihi et al., 2025). However, granular analysis challenged this generalization by revealing that Language Education students represent a positive anomaly. Their ethical and regulatory scores were statistically indistinguishable from those of Exact Science students and significantly higher than those of other non-exact Sciences. This finding extends the work of Wang et al. (2025), who noted that translation students exhibit unique motivational drivers for AI use. It confirms that the 'Non-Exact Sciences' label is overgeneralized to be a reliable predictor of AI ethics. Instead, 'Disciplinary Sensitivity' appears to be the primary driver, where the specific norms of an 'academic tribe' exert a stronger influence on AI adoption than the general field of study (Ursavaş et al., 2025).

b. Epistemological Proximity: Text as an Ontological Object

The heightened ethical vigilance observed among pre-service language teachers can be explained through the lens of Epistemological Proximity. For students in "hard-pure" sciences, text is often a vehicle for reporting data; however, for language students, text production is the process of knowledge constitution itself (North, 2005). As noted by Neuman (2001), "soft-pure" and "soft-applied" disciplines operate under epistemological codes that prioritize personal interpretation and the integrity of the written word. The emergence of GenAI, which automates text production, therefore represents a direct existential threat to the core ontology of language studies. This aligns with Sevryugina & Li (2026), who found that patterns of academic misconduct vary significantly across disciplines, suggesting that students in text-heavy fields are innately more sensitive to tools that disrupt textual ownership. It is crucial to clarify that this heightened regulatory demand does not stem from technological aversion. Indeed, studies in EFL classrooms demonstrate that students respond with high enthusiasm and positive perception when technology is used for engagement, such as in gamified vocabulary learning (Azzahra & Kembaren, 2025). However, unlike gamification, which supports learning, GenAI is perceived as a tool that potentially bypasses the learning process of text production. Thus, their stance reflects a 'protective disciplinary instinct' rather than a rejection of digital innovation.

c. The Psychology of Resistance: Anxiety as a Mediator

It is crucial to interpret the high "Regulatory Demand" scores not as resistance to innovation, but as a calculated response to risk. Cengiz & Peker (2025) argue that while students accept the utility of AI, this acceptance is concurrently mediated by high levels of "AI Anxiety," particularly regarding their future professional relevance. For pre-service language teachers, the uncertainty of how AI impacts their future profession induces what Khlaif et al. (2025) term "technostress". Furthermore, Shrivastava (2025) proposes a multi-theoretical framework suggesting that "perceived risk" (such as privacy and ethical concerns) actively amplifies resistance or caution. The Language students in this study appear to be engaged in a high-stakes risk calculation: they recognize the utility of AI but are acutely aware of the ethical pitfalls, leading to a demand for stricter control. This behavior reflects a high degree of "teacher agency," where students actively negotiate their engagement with technology rather than passively adopting it (Lee et al., 2025).

d. Navigating the "Grey Areas": The Demand for Regulatory Clarity

The finding that both Exact Sciences and Language students perceive current rules as "grey" or "ambiguous" confirms the existence of a global "policy vacuum" in higher education. Pike et al. (2025) warn that such ambiguity creates "grey areas" that cause significant distress for students who want to act ethically but lack clear guidelines. As noted by Smit et al. (2025), vague regulations lead to "moral hazards," where the lack of clarity forces students to make high-stakes ethical decisions without institutional support. This study demonstrates that students with higher digital literacy (Exact Sciences) and higher disciplinary sensitivity (Language Education) are the first to detect these regulatory voids. They do not need prohibitions; they demand what Moore & Lookadoo (2024) describe as "communicating clear guidance" to safely navigate the intersection of collaboration and plagiarism.

e. Implications: Towards Assessment Literacy

The convergence of ethical awareness between Language Education and Exact Sciences students implies that a "one-size-fits-all" policy is obsolete. Instead, institutions must move towards Disciplinary-Sensitive AI Literacy. For language education, the focus must shift from policing to pedagogy. As suggested by Deep et al. (2025), reliance on AI detection tools poses ethical concerns regarding false positives and surveillance. Therefore, the solution lies in "AI Assessment Literacy" (Khlaif et al., 2025), where educators are trained to redesign assessments that value process over product, ensuring that academic integrity is maintained through authentic engagement rather than punitive measures (Castillo-Cuesta, 2025).

4. CONCLUSION

This study empirically validates the concept of 'Disciplinary Sensitivity' as a far more robust predictor of AI ethical awareness than the traditional STEM versus non-STEM binary. The statistical confirmation of the 'Language Education Anomaly', whereby students in a text-centric discipline exhibited ethical vigilance (Mean Rank = 419.64) and regulatory demands (Mean Rank = 403.17) identical to those of Exact Sciences students (p = 1.000), and significantly higher than other Non-Exact Sciences ($p < .001$), proves that epistemological proximity dictates AI perception. The implication is profound: students whose core disciplinary ontology relies on text production do not resist AI out of technophobia, but rather demand strict regulation because GenAI directly disrupts the foundational integrity of their academic competence. The generic 'Non-Exact Sciences' categorization is therefore empirically obsolete for future technology adoption frameworks.

To address the prevailing regulatory ambiguity, institutional governance must urgently pivot from normative, 'one-size-fits-all' prohibitions toward concrete, discipline-based AI literacy models. We recommend two specific implementation strategies. First, at the policy level, universities should decentralize GenAI guidelines by adopting faculty-specific regulatory matrices. For instance, institutional policies must explicitly delineate the boundary between acceptable AI use (e.g., as a brainstorming or syntax-checking partner) and academic misconduct (e.g., automated text generation) specifically tailored for language programs. Second, at the pedagogical level, curriculum designers must operationalize 'AI Assessment Literacy' by redesigning evaluation methods. Rather than relying on punitive AI detection tools, language educators should implement process-oriented assessments (such as version-history tracking, drafting portfolios, and oral defenses) to ensure textual authenticity.

Despite its significant contributions, this study acknowledges several methodological limitations. First, the data were collected using a cross-sectional survey from a single private university in Indonesia, which may limit the generalizability of the findings to broader educational contexts and precludes the ability to establish definitive causal relationships. Second, the reliance on quantitative self-reported questionnaire data might oversimplify the nuanced cognitive processes underlying students' ethical judgments. Future research should address these limitations by extending these concrete frameworks through longitudinal qualitative studies to evaluate the efficacy of such discipline-specific policies.

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