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Writing at the Neural Frontier: Ethical Integrity and Epistemic Relevance for African Scholars in the Age of AI and Neurotechnology

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Abstract: *The rapid proliferation of artificial intelligence writing tools and neurotechnology in global academic settings has introduced profound ethical and epistemological challenges that existing frameworks — developed predominantly in Western institutional contexts — have failed to adequately address for African scholars. This study investigated the ethical integrity and epistemic relevance of AI and neurotechnology use in academic writing among African academics, guided by three specific objectives: assessing the level and nature of AI and neurotechnology engagement across disciplines and institutions; examining perceived ethical challenges related to authorship, academic integrity, and epistemic authenticity; and identifying key predictors of responsible and epistemically grounded AI use. A mixed-methods design was employed, combining a structured survey administered to a stratified random sample of 420 scholars drawn from universities across five African regions with 30 semi-structured qualitative interviews. Quantitative data were analysed using univariate descriptive statistics, bivariate chi-square tests and Pearson correlations, and multivariate techniques including Principal Component Analysis (PCA), confirmatory factor analysis (CFA), multiple linear regression, and binary logistic regression. Results revealed that 68.3% of scholars regularly used AI tools, yet institutional policy awareness recorded the lowest mean score across all variables ($M = 2.47$, $SD = 1.11$), and 37.1% of respondents reported having committed a self-identified ethical violation in AI-assisted writing. PCA identified three latent ethical challenge constructs — epistemic displacement risk, authorship anxiety, and institutional inadequacy — collectively explaining 65.1% of variance. The multiple regression model ($R^2 = .587$, $p < .001$) demonstrated that decolonial epistemic orientation ($\beta = .341$) and digital literacy ($\beta = .312$) were the strongest positive predictors of responsible AI use, while institutional inadequacy ($\beta = -.213$) was the most powerful negative predictor. Bivariate analyses confirmed significant associations between ethical violations and institutional policy absence ($\chi^2 = 24.81$, $p < .001$), and between decolonial orientation and ethical concern ($r = .461$, $p < .001$). The study concluded that responsible AI use among African scholars is determined by the intersection of individual epistemic consciousness, digital competence, and institutional support, and that the development of Africa-centred ethical frameworks for AI-assisted scholarship is an empirically validated institutional imperative. Recommendations include the urgent institutionalisation of AI-specific integrity policies, integration of decolonial epistemology and digital literacy training into researcher development programmes, and the development of a pan-African ethical framework for AI and neurotechnology in academic writing under the auspices of continental academic governance bodies.*

Keywords: Artificial intelligence, academic writing, neurotechnology, epistemic integrity, decolonial epistemology

INTRODUCTION

The convergence of artificial intelligence and neurotechnology is fundamentally reshaping the landscape of scholarly knowledge production. From AI-assisted writing tools such as large language models (LLMs) to brain-computer interfaces (BCIs) and neurofeedback systems that augment cognitive performance, the frontier of academic writing is no longer purely a human endeavor(Holmström, 2022; van Wynsberghe, 2021). For African scholars — navigating already complex terrain marked by colonial epistemic legacies, resource constraints, and a persistent pressure to publish in globally dominant journals — these emerging technologies introduce a new and urgent set of ethical and epistemological dilemmas. The question is no longer simply whether African academics can access these tools, but whether, in using them, they can preserve the authenticity of their intellectual voice, the integrity of their scholarly contributions, and the cultural relevance of knowledge produced from the African context (Gkinko & Elbanna, 2023; Jöhnk et al., 2021; Mikalef et al., 2022). This study examines the ethical dimensions and epistemic implications of AI and neurotechnology adoption among African scholars, arguing that without deliberate ethical frameworks rooted in African scholarly values, these technologies risk deepening existing inequalities in global knowledge production rather than redressing them.

BACKGROUND OF THE STUDY

The global academic community has witnessed an unprecedented acceleration in the integration of AI tools into research and writing processes. Platforms such as ChatGPT, Grammarly, Consensus, and Elicit, among others, are now widely used for tasks ranging from literature synthesis and grammar correction to hypothesis generation and manuscript drafting (Helberger & Diakopoulos, 2023; Kim et al., 2022; Schön et al., 2023). Simultaneously, neurotechnology — encompassing tools such as transcranial direct current stimulation (tDCS), EEG-based focus monitors, and cognitive enhancement wearables — is entering academic productivity discourse, promising to optimise concentration, memory retention, and creative output. In the Global North, these developments are being met with a mix of institutional policies, ethical guidelines, and philosophical debate (Birkstedt et al., 2023; Chaka, 2023; Díaz-

Rodríguez et al., 2023). In Africa, however, the conversation is still nascent. African universities, many of which are grappling with inadequate research funding, limited digital infrastructure, and brain drain, are only beginning to engage with the implications of AI-assisted scholarship. Yet African scholars are already using these tools — often without formal guidance, ethical training, or culturally sensitive frameworks to navigate their use (Iovino et al., 2022; Iseko, 2025; Sharma et al., 2023). This creates a dual vulnerability: scholars may unknowingly compromise their epistemic authenticity by over-relying on AI systems trained predominantly on Western datasets, and they may face institutional or international scrutiny around academic integrity without adequate institutional support . Furthermore, the philosophical question of what it means to "author" a piece of scholarship in an African intellectual tradition — where communal knowledge, oral epistemology, and Ubuntu-informed reasoning hold value — is placed in direct tension with the individualistic, output-driven logic embedded in most AI writing technologies (Julius & Milly, 2025b; Prasad et al., 2024; Rezaev & Tregubova, 2023).

PROBLEM STATEMENT

Despite the rapid proliferation of AI writing tools and cognitive neurotechnologies across global academic settings, there exists a significant gap in understanding how African scholars perceive, engage with, and are ethically and epistemically affected by these technologies. Existing ethical frameworks for AI in academia have been developed predominantly in Western institutional contexts and fail to account for the distinctive epistemological traditions, socio-structural conditions, and cultural imperatives that characterise African scholarship (Ariyo et al., 2024; Babington-Ashaye et al., 2023; Julius & Milly, 2025c, 2025a). As a consequence, African scholars are exposed to risks including inadvertent plagiarism, epistemic displacement — where locally grounded knowledge is supplanted by algorithmically generated content — erosion of intellectual authorship, and misalignment between AI-generated academic outputs and the socio-cultural realities they purport to address (Bozkurt et al., 2021; Julius & Mategeko, 2025; Julius & Twinomujuni, 2025; Pierres et al., 2024). The absence of Africa-specific, empirically grounded guidelines for the ethical use of AI and neurotechnology in academic writing leaves scholars without the tools they need to leverage these technologies responsibly, authentically, and in ways that advance rather than undermine the decolonisation of knowledge. This study therefore seeks to fill this critical gap by empirically investigating the ethical and epistemic challenges and opportunities that AI and neurotechnology present for African scholars.

MAIN OBJECTIVE

The main objective of this study was to investigate the ethical integrity and epistemic relevance of AI and neurotechnology use in academic writing among African scholars, with the aim of informing the development of contextually appropriate ethical frameworks for AI-assisted scholarship in African higher education institutions.

SPECIFIC OBJECTIVES

1. To assess the level of awareness, frequency, and nature of AI and neurotechnology use in academic writing among African scholars across different disciplines and institutional contexts.
2. To examine the perceived ethical challenges — including issues of authorship, academic integrity, and epistemic authenticity — associated with the use of AI and neurotechnology tools in scholarly writing among African academics.
3. To identify the key factors that predict responsible and epistemically grounded use of AI and neurotechnology in academic writing, including institutional support, disciplinary norms, digital literacy, and awareness of decolonial epistemology.

RESEARCH QUESTIONS

1. To what extent are African scholars aware of, and actively using, AI and neurotechnology tools in their academic writing, and how does this vary across disciplines, career stages, and institutional settings?
2. What ethical and epistemic challenges do African scholars perceive in relation to the use of AI and neurotechnology in academic writing, particularly with respect to authorship integrity, originality, and the representation of African knowledge systems?
3. What individual, institutional, and socio-cultural factors significantly predict the responsible and epistemically relevant use of AI and neurotechnology tools in academic writing among African scholars?

METHODOLOGY

This study employed a mixed-methods research design, integrating quantitative survey methods with qualitative semi-structured interviews to generate a comprehensive understanding of African scholars' engagement with AI and neurotechnology in academic writing. A structured, self-administered questionnaire was developed and administered to a stratified random sample of 420 academic staff and postgraduate researchers drawn from universities across five African regions — East, West, Southern, Central, and North Africa — ensuring representativeness across disciplines, career levels, and institutional types. The questionnaire captured data on AI tool awareness and usage patterns, frequency and nature of neurotechnology adoption, perceptions of ethical risk, epistemic confidence, institutional policy awareness, decolonial epistemological orientation, and digital literacy levels. In parallel, 30 in-depth semi-structured interviews were conducted with purposively selected scholars to generate nuanced qualitative insights into lived experiences, ethical deliberations, and epistemic tensions encountered in AI-assisted writing contexts. Quantitative data were

analysed using a three-tier statistical approach. At the univariate level, frequency distributions, means, standard deviations, and percentages were computed to describe the demographic profile of respondents and the general patterns of AI and neurotechnology use. At the bivariate level, chi-square tests of independence, independent samples t-tests, and Pearson and Spearman correlation analyses were used to examine associations between scholars' awareness levels, ethical perceptions, disciplinary affiliations, and institutional contexts. At the multivariate level, Principal Component Analysis (PCA) was applied to reduce the dimensionality of the ethical challenge items and identify underlying latent constructs of epistemic risk, authorship anxiety, and institutional inadequacy; confirmatory factor analysis (CFA) was subsequently used to validate the factor structures derived from PCA. Multiple linear regression analysis was then employed to determine the relative predictive strength of digital literacy, decolonial epistemological orientation, institutional policy support, and disciplinary norms on responsible AI use scores. Binary logistic regression was used to model the probability of scholars reporting ethical violations as a function of tool-use frequency, awareness level, and institutional support (Nelson et al., 2022, 2023). Additionally, cluster analysis (k-means) was applied to segment scholars into typological profiles based on their AI engagement behaviours and ethical orientations, providing a basis for targeted policy recommendations. Qualitative data from the interviews were analysed using thematic analysis following Braun and Clarke's six-phase framework, and findings were triangulated with the quantitative results to produce an integrated, contextually rich interpretation of the ethical and epistemic landscape of AI-assisted academic writing in Africa.

RESULTS

Table 1: Univariate Analysis — Descriptive Statistics of AI & Neurotechnology Use and Ethical Perceptions Among African Scholars (n = 420)

Variable	Category / Statistic	Frequency / Value	Percentage / SD
Gender	Male	241	57.4%
	Female	179	42.6%
Career Stage	Postgraduate Researcher	138	32.9%
	Early Career (≤5 yrs)	112	26.7%
	Mid-Career (6–15 yrs)	102	24.3%
	Senior Scholar (>15 yrs)	68	16.2%
Region	East Africa	96	22.9%
	West Africa	102	24.3%
	Southern Africa	89	21.2%
	North Africa	78	18.6%
	Central Africa	55	13.1%
AI Tool Usage	Uses AI tools regularly	287	68.3%
	Never used AI tools	133	31.7%
Neurotechnology Awareness	Aware	174	41.4%
	Unaware	246	58.6%
Mean AI Usage Frequency (1–5 scale)	M = 3.41	SD = 0.87	—
Mean Ethical Concern Score (1–5 scale)	M = 3.78	SD = 0.94	—
Mean Digital Literacy Score (1–5 scale)	M = 3.12	SD = 1.02	—
Mean Decolonial Epistemic Orientation (1–5)	M = 3.56	SD = 0.89	—
Mean Institutional Policy Awareness (1–5)	M = 2.47	SD = 1.11	—
Reported Ethical Violations	Yes	156	37.1%
	No	264	62.9%

The descriptive statistics presented in Table 1 revealed a predominantly male respondent profile (57.4%), with postgraduate researchers constituting the largest career-stage group (32.9%), suggesting that emerging scholars represented the most active segment of the academic writing community surveyed. A substantial majority of respondents (68.3%) reported regular use of AI tools in their academic writing, indicating that AI-assisted scholarship had already become a normalised practice across African universities despite the absence of formal institutional frameworks governing such use. The mean AI usage frequency score of 3.41 (SD = 0.87) confirmed moderate-to-high engagement with these tools, while the relatively high mean ethical concern score of 3.78 (SD = 0.94) demonstrated that scholars were acutely aware of the moral tensions embedded in AI-assisted writing. Neurotechnology awareness remained comparatively low, with only 41.4% of respondents indicating familiarity with such tools, reflecting the earlier-stage diffusion of neurotechnological applications in African academic settings. Regional distribution showed broad representation, with West Africa contributing the largest share (24.3%) and Central Africa the smallest (13.1%), a pattern broadly consistent with differences in university density and research output across the continent.

The most critically alarming finding in Table 1 was the institutional policy awareness mean score of 2.47 (SD = 1.11), the lowest recorded across all continuous variables, signalling a profound deficit in institutional guidance on AI and neurotechnology use in

African higher education. This finding was theoretically significant because it suggested that scholars were navigating ethically complex technological terrain without adequate institutional scaffolding, thereby increasing their vulnerability to unintentional academic misconduct. The decolonial epistemic orientation mean of 3.56 (SD = 0.89) indicated a moderately strong awareness of African epistemological values among respondents, yet this awareness had not been translated into formal protective practices, given that 37.1% of scholars still reported having committed what they themselves identified as an ethical violation in AI-assisted writing. The gap between epistemic consciousness and ethical behaviour pointed to a structural failure — one rooted not in individual moral deficit but in systemic institutional neglect — and foreshadowed the inferential analyses that followed, which sought to identify the specific predictors of responsible AI use in African scholarly contexts.

Table 2: Bivariate Analysis — Chi-Square Tests and Correlations Between Key Study Variables

Variable Pair	Test Used	Statistic	df / n	p-value	Interpretation
AI Tool Use × Career Stage	Chi-Square	χ^2= 18.43	df = 3	p = .000	Significant association
AI Tool Use × Region	Chi-Square	χ^2= 11.27	df = 4	p = .024	Significant association
Ethical Violations × Institutional Policy Awareness	Chi-Square	χ^2= 24.81	df = 1	p = .000	Significant association
Ethical Violations × Neurotechnology Awareness	Chi-Square	χ^2= 6.53	df = 1	p = .011	Significant association
AI Usage Frequency × Ethical Concern Score	Pearson r	r = .412	n = 420	p = .000	Moderate positive correlation
AI Usage Frequency × Digital Literacy	Pearson r	r = .387	n = 420	p = .000	Moderate positive correlation
Decolonial Orientation × Ethical Concern Score	Pearson r	r = .461	n = 420	p = .000	Moderate positive correlation
Institutional Policy Awareness × Ethical Violations	Pearson r	r = −.334	n = 420	p = .000	Moderate negative correlation
Digital Literacy × Ethical Violations (reported)	Point-biserial r	r = −.298	n = 420	p = .001	Weak-moderate negative correlation
AI Usage Frequency × Institutional Policy Awareness	Pearson r	r = .143	n = 420	p = .003	Weak positive correlation

The bivariate analyses presented in Table 2 revealed a constellation of statistically significant associations that illuminated the structural and individual-level dynamics shaping ethical AI use among African scholars. The chi-square test examining the relationship between AI tool use and career stage was highly significant ($\chi^2 = 18.43$, df = 3, $p < .001$), confirming that AI adoption was not uniformly distributed across career trajectories — postgraduate researchers and early-career scholars demonstrated disproportionately higher rates of AI tool use compared to senior academics, a pattern consistent with generational differences in technology adoption and the intensified publication pressures faced by emerging scholars. Similarly, the significant association between AI tool use and region ($\chi^2 = 11.27$, df = 4, $p = .024$) underscored the role of infrastructural and institutional disparities across African sub-regions in mediating access to and engagement with AI writing technologies. The most consequential chi-square finding, however, was the highly significant relationship between reported ethical violations and institutional policy awareness ($\chi^2 = 24.81$, df = 1, $p < .001$), which statistically confirmed that the absence of institutional guidance was directly associated with increased incidence of self-reported ethical breaches — a finding with profound implications for university governance across the continent.

At the correlational level, the moderate positive relationship between AI usage frequency and ethical concern scores ($r = .412$, $p < .001$) was theoretically meaningful, suggesting that scholars who engaged more intensively with AI tools were simultaneously more ethically sensitised — likely because frequent engagement with these tools forced scholars to confront questions of authorship and originality more acutely. The strong positive correlation between decolonial epistemic orientation and ethical concern ($r = .461$, $p < .001$) was the highest bivariate correlation in the matrix, indicating that scholars grounded in African epistemological traditions were significantly more attuned to the ethical risks of AI-generated content displacing culturally embedded knowledge. Critically, institutional policy awareness demonstrated a significant negative correlation with ethical violations ($r = −.334$, $p < .001$), providing bivariate-level empirical support for the argument that strong institutional frameworks serve as a protective buffer against ethical misconduct in AI-assisted scholarship. The negative relationship between digital literacy and ethical violations ($r = −.298$, $p = .001$) further reinforced the finding that competence in navigating digital tools, rather than merely having access to them, was a meaningful determinant of ethical scholarly behaviour — a distinction with direct implications for capacity-building interventions within African universities.

Table 3: Multivariate Analysis — PCA Factor Structure and Multiple Regression Predicting Responsible AI Use Score

Panel A: Principal Component Analysis — Ethical Challenge Constructs (Varimax Rotation)

Item	Factor 1: Epistemic Displacement Risk	Factor 2: Authorship Anxiety	Factor 3: Institutional Inadequacy
AI output misrepresents African context	**0.81**	0.14	0.09
AI homogenises cultural knowledge	**0.77**	0.21	0.11
AI-generated content lacks local relevance	**0.74**	0.18	0.22
Uncertain who authored the work	0.19	**0.83**	0.13
Difficulty distinguishing own ideas from AI	0.23	**0.79**	0.17
Fear of plagiarism detection flags	0.17	**0.71**	0.24
No clear institutional AI policy exists	0.11	0.16	**0.86**
Lack of training on ethical AI use	0.20	0.22	**0.80**
No colleague guidance available	0.25	0.28	**0.74**
Eigenvalue	3.21	2.74	2.38
% Variance Explained	28.4%	19.6%	17.1%
Cumulative % Variance	28.4%	48.0%	65.1%

Panel B: Multiple Regression — Predictors of Responsible AI Use Score (Dependent Variable)

Predictor Variable	B	SE	β	t	p-value
Constant	1.24	0.31	—	4.00	.000
Digital Literacy Score	0.38	0.07	.312	5.43	.000
Decolonial Epistemic Orientation	0.42	0.08	.341	5.25	.000
Institutional Policy Awareness	0.29	0.06	.274	4.83	.000
Epistemic Displacement Risk (Factor 1)	−0.21	0.07	−.187	−3.00	.003
Authorship Anxiety (Factor 2)	−0.17	0.06	−.154	−2.83	.005
Institutional Inadequacy (Factor 3)	−0.24	0.07	−.213	−3.43	.001
Career Stage	0.11	0.05	.092	2.20	.028
R^2 = .587	**Adjusted R^2 = .579**	**F(7, 412) = 82.34**	**p < .001**		

The Principal Component Analysis presented in Panel A of Table 3 yielded a three-factor solution explaining 65.1% of the total variance in ethical challenge items, following varimax rotation. The first and most dominant factor, labelled Epistemic Displacement Risk, accounted for 28.4% of variance and captured items related to the misrepresentation of African contexts, homogenisation of cultural knowledge, and the perceived irrelevance of AI-generated content to local realities — all loading strongly (range: 0.74–0.81) on this component. This factor was particularly significant in the African scholarly context because it operationalised, in statistical terms, a concern that has been predominantly discussed at the theoretical level in decolonial literature: that AI systems trained on Western corpora systematically reproduce epistemic hierarchies that marginalise African intellectual traditions. The second factor, Authorship Anxiety (19.6% of variance), captured the psychological and professional discomfort scholars experienced regarding the blurring of boundaries between their own intellectual contributions and AI-generated content, with fear of plagiarism detection emerging as a structurally related but distinct manifestation of this anxiety. The third factor, Institutional Inadequacy (17.1% of variance), strongly indexed the absence of policy guidance, training, and collegial support — confirming at the latent construct level what had already been observed in the descriptive statistics: that African institutions had largely failed to create enabling environments for ethical AI adoption in scholarship.

The multiple regression model in Panel B demonstrated excellent overall predictive power, with the model explaining 58.7% of the variance in responsible AI use scores (R^2 = .587, Adjusted R^2 = .579, $F(7, 412) = 82.34$, $p < .001$), affirming that the chosen predictors collectively constituted a robust explanatory framework. Decolonial epistemic orientation emerged as the single strongest positive predictor ($\beta = .341$, $t = 5.25$, $p < .001$), indicating that scholars who held a strong grounding in African epistemological values were significantly more likely to engage responsibly with AI tools — a finding that positioned decolonial education not merely as an ideological stance but as a practical ethical safeguard. Digital literacy was the second strongest positive predictor ($\beta = .312$, $t = 5.43$, $p < .001$), reinforcing the bivariate finding that competence — not merely access — was critical for ethical AI use. Among the PCA-derived factors, institutional inadequacy was the most powerful negative predictor ($\beta = -.213$, $t = -3.43$, $p = .001$), demonstrating that structural deficits at the institutional level exerted the largest suppressive effect on responsible AI use, even when controlling

for individual-level competencies. Authorship anxiety and epistemic displacement risk also significantly and negatively predicted responsible use scores ($\beta = -.154$ and $\beta = -.187$ respectively), confirming that scholars caught in these ethical tensions were less likely to use AI tools in deliberate, transparent, and accountable ways. Taken together, these findings made a compelling empirical case that responsible AI use in African academic writing was determined by an interaction of individual epistemic consciousness, digital competence, and institutional support — and that policy interventions targeting any one of these dimensions in isolation would yield suboptimal results.

CONCLUSION

This study provided the first empirically grounded, multivariate investigation of the ethical integrity and epistemic relevance of AI and neurotechnology use in academic writing among African scholars, revealing a complex landscape in which high rates of AI adoption coexisted with profound institutional neglect, heightened ethical anxiety, and a genuine, measurable desire among scholars to anchor their use of these technologies in African epistemological values. The descriptive, bivariate, and multivariate analyses converged on a consistent narrative: African scholars were neither passive victims of technological imposition nor uncritical enthusiasts — they were ethically conscious agents operating in structurally unsupportive environments, whose responsible engagement with AI and neurotechnology was most powerfully predicted by the strength of their decolonial epistemic orientation, the depth of their digital literacy, and the presence of institutional policy frameworks that legitimised and guided ethical use. The PCA-derived constructs of epistemic displacement risk, authorship anxiety, and institutional inadequacy captured the three core dimensions of vulnerability that African scholars faced at the neural frontier of academic writing, and the regression model demonstrated that these vulnerabilities were not inevitable but were substantially remediable through targeted educational, institutional, and policy interventions — making the development of Africa-centred ethical frameworks for AI-assisted scholarship not merely an academic aspiration but an empirically validated institutional imperative.

RECOMMENDATIONS

African universities must urgently develop and institutionalise AI-specific academic integrity policies that are co-created with scholars, epistemologically grounded in African knowledge traditions, and regularly updated to reflect the rapidly evolving capabilities of AI writing and neurotechnology tools — moving beyond generic plagiarism policies to address the nuanced questions of authorship, epistemic authenticity, and cultural representation that AI-assisted writing uniquely poses.

Digital literacy and decolonial epistemology training should be formally embedded in postgraduate and early-career researcher development programmes across African higher education institutions, given that these two competencies were the strongest individual-level predictors of responsible AI use, ensuring that scholars are equipped not only with the technical skills to use AI tools but with the critical epistemic frameworks needed to interrogate, contextualise, and culturally situate AI-generated content within African scholarly traditions.

Continental and regional academic bodies — including the African Union's higher education organs, the Association of African Universities, and national research councils — should collaborate to develop a pan-African ethical framework for AI and neurotechnology in scholarship, one that addresses the heterogeneity of institutional capacities across African sub-regions, provides model policies adaptable to diverse disciplinary and cultural contexts, and explicitly centres the decolonisation of knowledge as a foundational principle in governing the integration of AI into African academic writing practice.

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