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Artificial Intelligence as an Integral Component of the Digital Culture within Contemporary Higher Education

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ABSTRACT

Purpose of the study: Purpose of this study is to formalize a framework for the integration of AI into higher education, predicated on an analysis of cognitive transformations, subjective strategies, and regulatory frameworks for intervention.

Methodology: The methods employed in this study encompass cognitive-discursive calibration, expert rubricative assessment, NLP analysis of academic texts, hybrid modeling of textogenesis, inter-iterative comparative analysis, a dispersion questionnaire of students, an expert scale survey of educators, ontological normative modeling.

Main Findings: Through inter-iterative analysis, a notable increase in argumentative complexity (+14.1%), cognitive complexity (+21.2%), and syntactic complexity (+19.4%) was observed, alongside an enhancement in coherence (+14.6%). Conversely, there was a simultaneous decrease in subjectivity (−7.5%) and a significant increase in AI-discriminant weight (+180.2%). Instances of complete generation were recorded in 16% of cases, indicative of hyperdelegation and the erosion of intentionality; the survey revealed epistemological polarization regarding the AI perception. In response to these identified factors, a stratified framework has been developed, prioritizing cognitive non-delegation, semantic traceability, and subjective accountability, which aims to ensure the stabilization of cognitive sovereignty and digital autonomy.

Novelty/Originality of this study: The scientific novelty of this study lies in developing a formalized framework for integrating artificial intelligence into higher education, emphasizing cognitive traceability, subjective accountability, and normative stratification. This framework systematically aligns AI-mediated educational processes with ethical standards and pedagogical imperatives, ensuring responsible technological integration that supports transparency, learner agency, and sustainable academic governance within digital learning environments.

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1. INTRODUCTION

Against the backdrop of profound digital transformation within educational landscape, the examination of the influence exerted by generative artificial intelligence systems on cognitive and communicative practices within academic interactions has become increasingly pertinent. The pronounced surge in the accessibility of Large Language Models (LLMs) has caused a discursive shift in the learning paradigm, necessitating not only technological but also ethical and methodological comprehension of the functional role of AI within the framework of educational activities. The challenge of delineating the boundaries of permissible AI involvement, its effects on the cognitive autonomy of learners, as well as the risks associated with algorithmic desemanticization of knowledge demands a comprehensive empirical-theoretical analysis [1]-[3].

At the same time, the strategic perspective in terms of AI's institutionalization in educational context should be anchored in a value-centric paradigm, which precludes the reduction of the educational process to mere algorithmic functions [4]-[6]. Higher education institutions are increasingly envisaged as regulators of humanitarian security, tasked with mitigating the anthropological risks inherent in the digital age through the cultivation of normatively stable value dispositions capable of counteracting cognitive depersonalization [7]-[9]. Central to this discourse is the bioethical dimension of educational policy, which interweaves mechanisms of moral accountability into the process of critically evaluating AI tools in education. Such an reevaluation of the university's role amid cognitive-algorithmic influences fosters an enhancement of epistemic subjectivity and cognitive security [10]-[12].

Despite the presence of numerous declarative approaches to the regulatory oversight of AI in educational settings, there are still no verified models of cognitive-institutional integration. The latter models should accommodate the variability of AI interventions, the didactic intricacies of educational content, as well as the epistemic identities of participants in the educational process. The imperative to combine indicative monitoring of cognitive performance with normative stratification of ethical and technological parameters governing the use of AI necessitates the development of ontologically formalized regulatory frameworks [13]-[15].

The purpose of this study is to formalize a structural and institutional framework for the integration of generative AI agents into higher education. This aim will be realized through a synthesis of experimental analysis of cognitive-discursive transformations, dispersive modeling of subjective strategies for interaction with AI, and the development of a normative framework governing permissible AI intervention. Importantly, this initiative is anchored in the principles of cognitive non-delegation, semantic traceability, and epistemic transparency [16]-[18].

The research tasks aimed at fulfilling this purpose are delineated as follows: to carry out a cognitive-discursive calibration of text production within the framework of autonomous writing without the involvement of generative AI; to undertake an expert rubricative evaluation of the cognitive and discursive parameters inherent in academic texts; to implement NLP analysis of the essay corpus through the utilization of syntactic parsing, Sentence-BERT, Coh-Metrix, and AI-discriminant tools; to model a hybrid textogenesis process predicated on the integration of large language models (LLMs) as cognitive facilitators; to perform an inter-iterative comparative analysis of seven cognitive-discursive metrics under two distinct modalities of textogenesis; to administer a variance questionnaire among students to stratify the degrees of AI integration within written products; to conduct an expert-scale survey of the instructors regarding the acceptability of AI within the educational process; to devise an ontologically formalized framework for the normative incorporation of AI into the higher education ecosystem.

Within the framework of this section, a critical analysis of contemporary scientific publications elucidating the foremost conceptual paradigms concerning the integration of artificial intelligence within the domain of higher education is conducted. The research encompasses the transformation of pedagogical models, institutional and ethical-cultural challenges, as well as technopedagogical strategies aimed at adapting educational ecosystems to the exigencies of a post-digital reality.

In particular, Padua [19] demonstrated that the incorporation of AI into educational ecosystems engenders a transformative shift in didactic models towards the Education 4.0 paradigm, accentuating the cultivation of cognitive autonomy, digital ethical competence, and critical digital thinking. What is more, an inclusive digital culture is perceived as a pivotal factor in surmounting educational asymmetry and digital fragmentation through multi-agent socio-pedagogical interaction. A similar perspective is shared by Qutieshat [20], conceptualizing AI as an instrument for educational equivalence through the lens of post-institutional pedagogy, digital inclusion, and self-determined learning. Within the ambit of transdisciplinary analysis, AI is regarded as a technological equalizer that eliminates educational stratification and ensures the realization of the principles of an emancipatory educational ecosystem.

Additionally, Levin, Bukhshtaber & Minyar-Beloruchev [21] positioned Generative AI as a technoepistemological shift in computer science that deconstructs algorithmic paradigms and actualizes contextual and emergent modeling. Within the framework of White's model, the necessity for the academic institutionalization of GenAI through transdisciplinary integration, project-cognitive strategies, and an adaptive competence framework is substantiated. Similarly, Nikolopoulou [22] characterized Generative AI as a tool for educational ecosustainability, facilitating cognitive personalization, resource optimization, and digital inclusivity

in higher education. The author emphasizes the imperative for normative reconfiguration of policies through the lens of environmental and ethical interoperability, alongside empirical verification of GAI practices.

A noticeable commitment to avant-garde approaches was exhibited by Ojha, Agrawal & Arya [23]. The scholars interpreted AI as a catalyst for inclusive pedagogy, emphasizing the risks of algorithmic discrimination, privacy, and ethical and legal illegitimacy. The expediency of introducing human-centered technopedagogical strategies through universal design, bias-mitigated architectures and inclusive-cognitive analytics is argued. Furthermore, optimization applicability was explored by Dixon & Cox [24], who explored the cognitive-affective representations of AI in higher education through the methodology of narrative modeling. The scholars captured the pragmatic orientation of users to enhance operational efficiency. Importantly, their study identified barriers to implementation associated with value misalignment, front-end coherence, and a limited extent of task delegation to AI agents.

The ethical discourse was delved into by Mumtaz, Carmichael, Weiss & Nimon-Peters [25]. These researchers discerned cross-cultural disparities in the perception of the ethical acceptability of employing Artificial Intelligence Technology (AIT) in business education through the application of Structural Topic Modeling, stratified by cultural dimensions as delineated by the Hofstede model. The findings underscore the necessity for a culturally nuanced ethical framework for the incorporation of AI tools within transnational educational contexts. Additional impediments were identified by Abbasi, Wu & Luo [26], who determined that institutional support, the AI proficiency of educators, and anticipated educational transformations are pivotal determinants of AI-centric curricular innovation. Notably, it was corroborated by logistic regression analyses on a global sample. However, barriers related to cognitive assimilation, ethical validation, and cultural incongruence hinder the scalability of AI integration in cross-contextual educational frameworks.

An imbalance in the perception of intelligent technologies was elucidated by Perera, Perera & Dissanayake [27] who exposed a cognitive-perceptual dichotomy between students and educators concerning EdTech awareness, wherein students regard Generative Artificial Intelligence (GAI) as an essential instrument for academic performance. The necessity for the institutionalization of AI-oriented pedagogical discourse and methodological adaptation through the incorporation of student agent-based feedback is articulated by the above-mentioned scholars.

Finally, Chami & Cockburn [28] emphasized the imperative for an ethical-humanitarian equilibrium between the AI-enhanced educational process and the preservation of authentic pedagogical interactions. The scholars substantiate the critical importance of ethically-centered integration through cognitive interoperability, the professionalization of the instructors' EdTech competencies, and the implementation of quality assurance strategies within the context of the technosocial transformation of higher education institutions (HEIs).

Artificial intelligence has already begun to alter the architecture of educational technology by reshaping learning design, assessment models, and mechanisms of student agency, yet the scholarly literature reveals a persistent research gap: the absence of an integrated framework that unifies AI-use policy, pedagogical configuration, and empirically verified cognitive effects within higher education. Existing contributions tend to fragment these dimensions, addressing algorithmic ethics or instructional innovation in isolation, without offering a coherent model for governing AI-mediated learning processes. At the same time, generative systems modify task complexity, influence feedback cycles, introduce new forms of cognitive delegation, and challenge the validity of traditional assessment practices, thereby necessitating a structured approach capable of aligning technological affordances with instructional design principles and institutional governance requirements.

A synthesis of the examined scholarly perspectives reveals that artificial intelligence is increasingly perceived not merely as a technological instrument, but as a foundational component of educational transformation. It is crucial to take into account the capacity to reconfigure didactic models, educational policies, cultural interactions, and ethical regulations. Simultaneously, the spectrum of identified challenges − ranging from value misalignment and algorithmic bias to cognitive fragmentation and normative uncertainty − highlights the necessity to cultivate a comprehensive theoretical and methodological vision of AI as an integral element of the digital culture within higher education. Consequently, further inquiry aimed at comprehending AI as a phenomenon of digital culture is particularly salient in the context of the post-digital evolution of the academic environment.

Despite the rapid diffusion of generative AI in higher education and its documented impact on learning design, formative feedback, automated assessment, and student agency, the current educational technology literature remains fragmented. Recent studies emphasize AI-driven personalization, adaptive assessment, and digital literacy development, yet they predominantly examine these domains in isolation, without integrating instructional design, writing assessment validity, and institutional AI governance into a single operational model. Moreover, empirical evidence on how generative AI reshapes assessment reliability, authorship attribution, and ethical academic practice remains methodologically inconsistent and institutionally underregulated. Consequently, a critical research gap persists in the absence of a unified, empirically grounded framework that systematically aligns AI-use policy, instructional design, writing assessment, and digital literacy within higher education governance structures.

2. RESEARCH METHOD

The methods employed in this study comprised several integrated approaches. First, cognitive benchmarking was conducted through individual academic text production without the involvement of generative AI systems, serving as a foundational reference for identifying parameters of autonomous writing productivity, including argumentative complexity, syntactic and coherent organization, and indicators of authorial subjectivity. Second, expert rubric evaluation was implemented using a structured analytical rubric with a multi-level scale to enable formalized measurement of cognitive and discursive parameters such as argumentation, reflection, and coherence within the essay corpus. Third, NLP-based analysis of academic texts was carried out using syntactic parsing models, sentence embedding techniques (Sentence-BERT), coherence metrics (Coh-Metrix), and AI-discriminant tools (GPTZero and ZeroGPT) to quantitatively assess cognitive complexity, syntactic depth, and AI intervention. Fourth, hybrid text generation was realized through the guided integration of a large language model (ChatGPT v3.5) as a cognitive facilitator, allowing students to independently determine the type and degree of AI involvement during the stages of idea generation, structuring, lexical optimization, and stylistic refinement. Fifth, an iterative comparative analysis was conducted to examine cognitive–discursive characteristics of essays produced under two conditions (with and without AI), incorporating metric-based comparisons across seven parameters: argumentative complexity, cognitive diversification, syntactic complexity, subjectivity, coherence, AI index, and compositional integration. Sixth, a dispersive student survey was administered following the second iteration of the experiment using a self-report method, in which levels of AI integration (ranging from none to total) were systematized and a scale of individual AI intervention was constructed based on statistical characteristics. Finally, ontological policy modeling was applied to formalize the framework for AI integration within the educational process by developing a table outlining normative-regulatory and cognitive-heuristic components along with their indicative effects.

2.1. Research Procedure

The study was conducted in several stages (Figure 1).

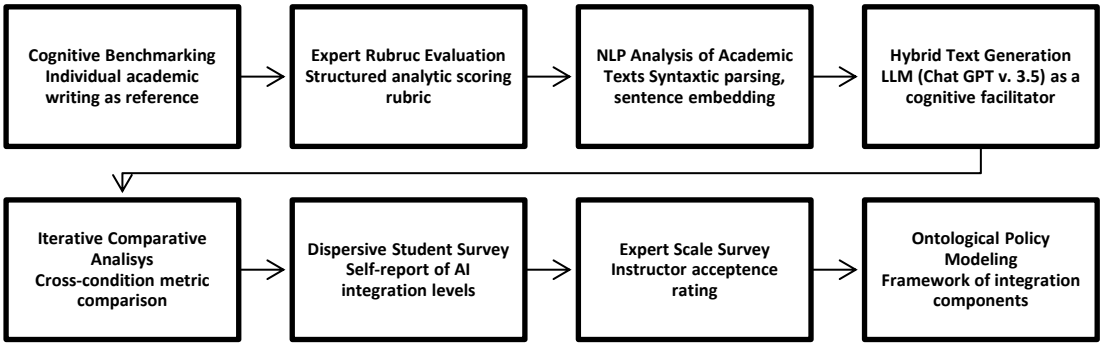

Figure 1. Research procedure

2.2. Sample

The study involved students from the Department of Philosophy and Religious Studies within the Faculty of Social Sciences and Humanities at Borys Grinchenko Kyiv Metropolitan University, specifically those enrolled in second-level (master's) programs of higher education. The sample comprised four academic groups, each consisting of 30 individuals, with a total number of N = 120 students. The stratified analysis did not uncover any statistically significant influence of the gender variable on the nature or quality of AI utilization in the text production process. The sample is characterized by a mixed-gender composition, yet remains gender-neutral concerning the study's dependent variables.

All participants had prior experience in composing academic essays, demonstrated fundamental digital literacy skills, and provided written informed consent to participate in the research experiment. This sample is relevant for evaluating the impact of AI on academic writing within the context of the humanities educational tradition, with particular emphasis on the value-semantic, ethical, and critical-analytical dimensions of digital culture. The sample also includes N = 42 instructors from the Department of Philosophy and Religious Studies at the Faculty of Social Sciences and Humanities of Borys Grinchenko Kyiv Metropolitan University, who gained experience in assessing student texts both prior to and following AI use.

2.3. Tools

For a scientifically rigorous evaluation of essays composed independently and those generated by AI, a comprehensive multidimensional scale was employed, encompassing cognitive-content, stylistic-communicative, ethical, and formal-analytical dimensions (Table 1). This methodology facilitated the discernment of variances in cognitive structuring, the depth of material exploration, as well as the extent of individual authorship.

Table 1. A formalized system of linguo-cognitive indicators to verify the influence of artificial intelligence on the structural and semantic parameters of academic discourse in the process of text production

Metric Name	Short description	Method of determination/measurement	Grading scale with interpretation of results	Current research on the use of the indicator
Argumentative complexity	Structural depth of logical-discursive construction of arguments	Peer review under an analytical rubric with clear level descriptors (1–5) covering the depth, logical structure, and coherence of arguments.	1 — no structure; 3 — partial logic; 5 — multilevel argumentation	Pratama, Widiati & Hakim [18]; Darmawansah, Rachman, Febiyani & Hwang [19]
Cognitive diversification	Level of variability of thought operations (analysis, synthesis, comparison)	Content analysis of the text with a focus on cognitive operations (classification, analysis, synthesis, comparison), confirmed by the assessment of experts on the Bloom/Anderson frame.	1 — one-dimensional thinking; 3 — single strategies; 5 — polystructural thinking	Yaacoub, Assaghir & Da-Rugna, [20]; Ji, Zhan, Li, Zou & Lyu [21]
Syntactic complexity	Depth of nesting of sentences and number of compound structures	Automated linguistic analysis using NLP libraries (TextStat, SpaCy): calculation of average sentence length, number of nested constructions, Gunning Fog Index.	1 — elementary sentences; 3 — basic difficulty; 5 — multilevel syntactic construction	Yang et al. [22]; Zeinalipour, Mehak, Parsamotamed , Maggini & Gori [23]
Indicators of authorial subjectivity*	Availability of self-identifications, reflective constructs and individual experiences	A coded expert assessment of the presence of elements of the author's position (reflection, experience, intonation) with verification through the student's self-report (questionnaire: % of own contribution, subjective involvement).	1 — complete absence; 3 — episodic personification; 5 — narrative integration of personal experience	Doru et al. [24]; Bevilacqua et al. [25];
AI-discriminant weight	Probability that the text is generated by AI	Algorithmic determination of the probability of AI text generation using GPTZero, Turnitin AI Detection or ZeroGPT: output of a probability scale with automatic distribution by categories.	0–30% — human text; 31–70% — mixed; 71–100% — mostly generated	Malik & Amjad [26]; Qorich & El Ouazzani [27];
Text coherence	Logical coherence, sequence of semantic transitions	The use of NLP tools (Coh-Metrix, sentence-BERT) to assess the logical-semantic coherence between text segments, with the calculation of the degree of coherence and semantic integrity.	1 — fragmentation; 3 — partial connectivity; 5 — high level of logical-semantic integration	Zhao [28]; Nikhil, Annamalai & Jayapal [29], Gavira Durón & Jiménez-Preciado [30]

* Indicators of authorial subjectivity were operationalized as the availability and density of self-identifications, reflective constructs, and individual experiences. Coded expert assessment targeted three clusters of markers:

– Self-identifications — explicit references to the author's role, stance, or personal agency (*I argue*, *in my analysis*).

– Reflective constructs — metacognitive commentary, evaluative or interpretative statements, epistemic modals indicating judgment or doubt.

– Individual experiences — narrative integration of personal context, lived examples, or affective intonation distinguishing authentic authorship from AI-neutral output.

Each text was scored on a 1–5 scale aligned with the previously defined categories (1 = complete absence; 3 = episodic personification; 5 = narrative integration of personal experience). Scores were then cross-validated with student self-reports (questionnaire: % own contribution, subjective involvement) to ensure metric reliability and replicability. This transparent coding grid captures shifts in stance density, reflective depth, and narrative individuation.

A comprehensive evaluation of essays in accordance with the parameters outlined in assessment of essays according to the parameters as follows (Table 1) has facilitated to empirically differentiate the effects of the use of AI, establish the degree of the author's cognitive autonomy, and develop conclusions about the ethical and pedagogical boundaries of AI's generative involvement in academic writing.

Content validity of the expert rubric was ensured through alignment with established indicators of argumentation, coherence, and authorial subjectivity, followed by expert calibration prior to scoring. Construct validity of the computational metrics (Coh-Metrix, Sentence-BERT, AI-discriminant tools) was supported by their documented acceptance in prior NLP and educational analytics research. Inter-rater reliability for expert coding was verified through repeated blind scoring and consistency checks, while the stability of quantitative indicators was confirmed through repeated measurements across two experimental iterations.

3. RESULTS AND DISCUSSION

As part of the first iteration of the experimental study, the procedure for individual academic text production was conducted, necessitating the autonomous composition of essays by students without any involvement from generative artificial intelligence systems. Methodologically, this iteration serves as a reference cognitive-discursive control, aimed at establishing the fundamental parameters of writing productivity, which encompass argumentative complexity, cognitive diversification, syntactic construction, author's reflection, and textual coherence. The resulting texts underwent a comprehensive assessment employing a structured expert rubric, NLP analysis tools, and analytical metrics of author's subjectivity, facilitating the identification of the level of cognitive autonomy and ethical integration of the student within the academic writing process (Figure 1).

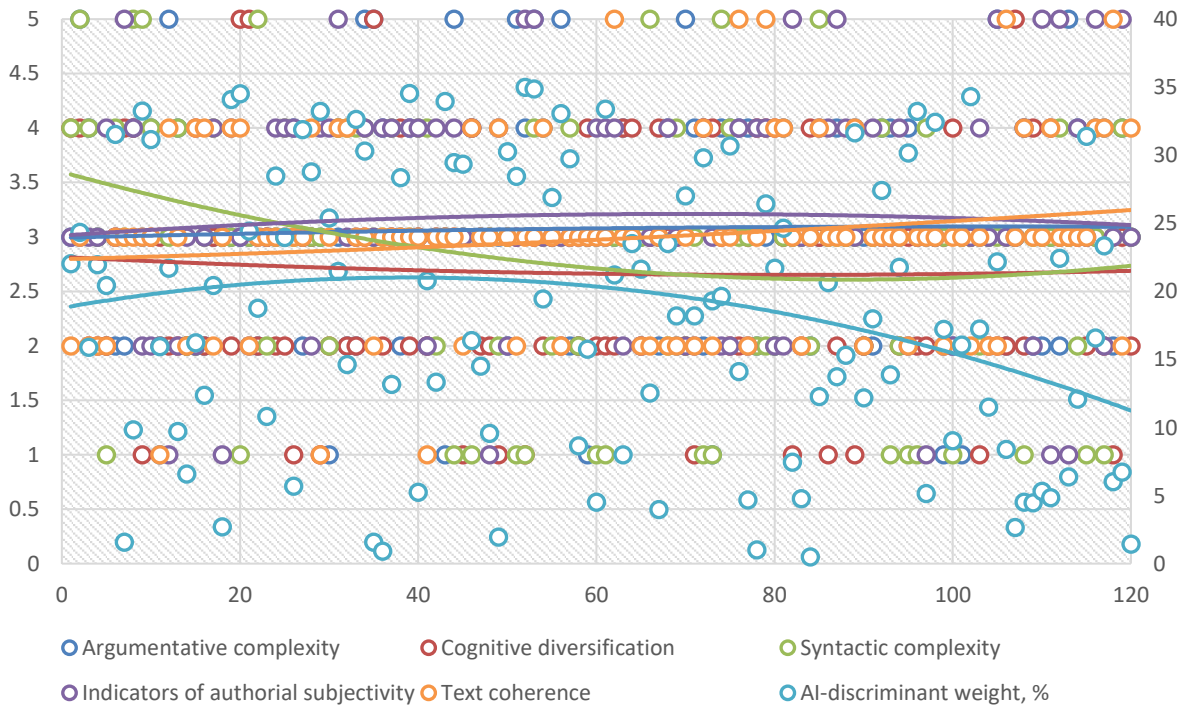

Figure 1. Graphical interpretation of the results of the first iteration of academic text production (without the use of AI generation)

As part of the first iteration of the empirical study, a polyparametric evaluation of 120 academic essays, generated in the mode of autonomous textogenesis without the involvement of generative artificial intelligence algorithms was conducted (Figure 2). The average metric of argumentative complexity (3.08) reveals the predominance of linearly expanded thesis constructions, characterized by limited interthematic stratification and insufficient deductive-inductive integration. The index of cognitive diversification (2.83) indicates a low frequency of complex cognitive operations (analytical comparison, conceptual synthesis, classification generalization), suggesting a reduced cognitive polyphony. Syntactic complexity (2.87) reflects a limited depth of structural nesting and a weak implementation of hypotactic mechanisms typically associated with high-level academic discourse. The parameter of indicators of authorial subjectivity (3.05) demonstrates fragmentary reflexive bias, manifested in the partial explication of narrative intention, experiential identification, and affective-modal interference. The average value of AI-discriminant weight (20.56%) confirms a substantial degree of textual authenticity, accompanied by a minimal probability of algorithmic intervention, thereby validating the ethical integrity of the initial iteration. Text coherence (3.04) illustrates the fundamental execution of logical-semantic chains through a minimal level of prosodic coherence and semantic framing. A comprehensive interpretation of the results enables us to define the cognitive-rhetorical profile of student texts as moderately autonomous, characterized by a moderate argumentative substructure, lexical and syntactic constraints, and low cognitive plasticity in the context of non-facilitated digital influence.

As part of the experimental study's second iteration, a regulated procedure for integrating generative artificial intelligence as a cognitive facilitator of academic writing was implemented. The objective of this stage was to empirically model the conditions of hybrid textogenesis , wherein the student employs AI tools as an auxiliary component in the construction of argumentative and reflective discourse. To standardize the intervention, the generative language model ChatGPT (v.3.5), accessible through an open web interface, was utilized. The functional application of AI permitted its deployment at various stages, This includes generation of ideas, formulation of the compositional structure, elucidation of the argumentative foundation, transformation of syntactic constructions, and verification of linguistic accuracy, provided that the autonomous contribution of the author and ethical accountability were preserved. The participants in the experiment were granted the autonomy to independently determine the nature and extent of AI support, thereby enabling the documentation of the actual instrumental involvement of AI components in the academic writing process − Figure 3.

Within the second iteration, a structural-metric evaluation of 120 academic essays produced under the conditions of assisted textogenesis utilizing generative language models (LLMs) was conducted, thereby enabling the empirical formalization in terms of AI mediation effects within the cognitive-discursive framework of higher education. The findings reveal a notable increase in the parameters of compositional complexity, cognitive polyphony, and textual coherence, accompanied by a reduction of the authorial intentionality as well as the indexing of the artificial trace within the essay's structure (Figure 3).

The average score for argumentative complexity stands at 3.69, which indicates an enhancement in the index of discursive stratification, particularly attributable to the generation of quasi-logical chains constructed in accordance with premise–support–conclusion schemas characteristic of LLM prompts. Cognitive diversification, rated at 3.65, reflects the enrichment of mental operations − analysis, synthesis, inductive generalization, and formal comparison − marked by a predominance of patterned cognitive schemas. The syntactic complexity at the level of 3.57, is a result of the escalating frequency of multicomponent clause structures, the use of relative clauses, abstract nominalizations, and passive constructions. The said characteristics are structurally relevant to the discourse of generative AI.

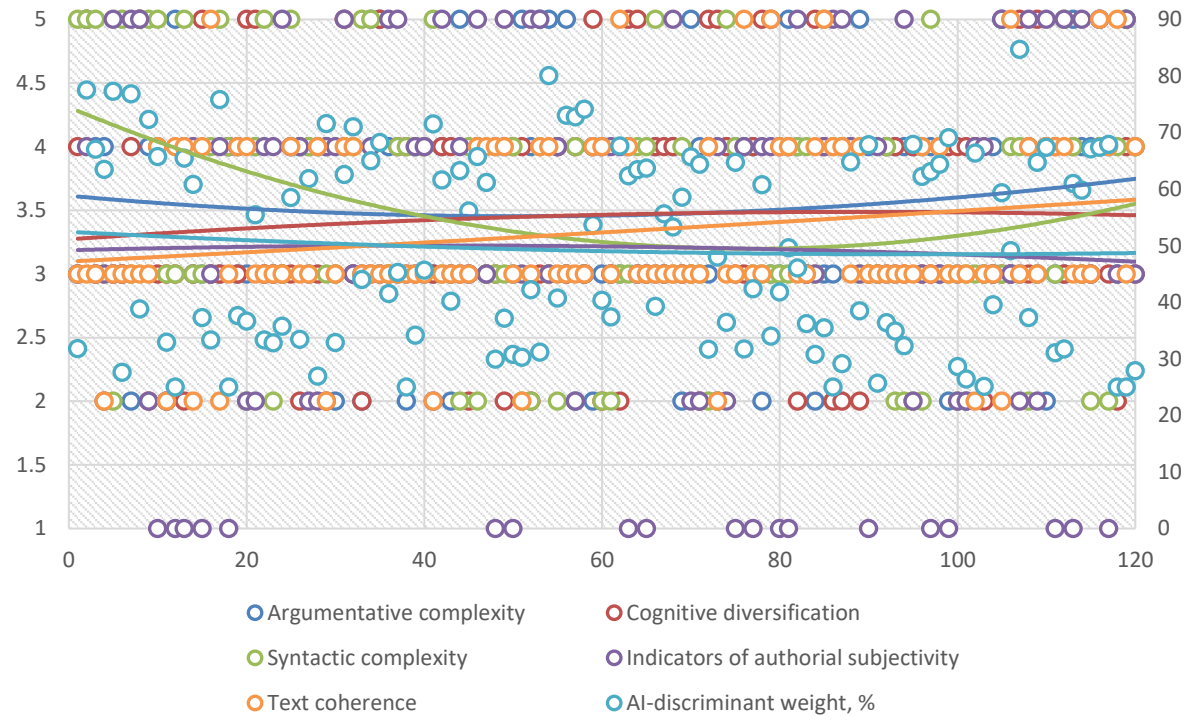

Figure 2. Graphical interpretation of the results of the second iteration of academic text production (using generative AI)

Indicators of the authorial subjectivity exhibit a notable polarization: an average value of 3.01 accompanied by a significant variance (ranging from 1 to 5), which indicates a partial desemanticization of the subjective dimension. This phenomenon is manifested through a reduction of reflective elements, a loss of narrative intonation, and a substitution of personal perspective with generalized formulations. The AI-discriminant weight (within the range of 26.3–74.9%, with a modal zone of 50–60%) substantiates a pronounced level of algorithmic interventionalism within the text corpus. This serves as evidence of cognitive delegation of productive functions to the AI agent. Text coherence (with an average score of 3.45) has improved due to automated macrostructure optimization, an increased frequency of logical connectors, and the stylistic harmonization of paragraphs.

In summary, the findings from the second iteration reveal a cognitive-mechanistic profile of writing, which amalgamates heightened formal structuring with concurrently diminished individual intentionality. The obtained data validate the hypothesis regarding AI's diffuse nature as an intellectual facilitator and a potential vector for authorial desubjectivation. This underscores the necessity for inter-iterative comparative analysis aimed at identifying cognitive deltas, the dynamics of discursive shifts, and the extent of functional replacement of cognitive operations by an artificial intelligence agent. Such analysis is critical for the formalization of the regulatory and pedagogical framework governing the utilization of AI in higher education as an integral component of digital culture (Figure 4 – Figure 9).

Inter-iterative comparative analysis in terms of the academic textogenesis results conducted under the conditions of AI models' controlled integration (Figure 4 – Figure 9) has unveiled significant dynamics in the evolution of structural-semantic, cognitive-compositional, and stylistic-discursive parameters of the essay. Compared to the first iteration (without AI), the subsequent iteration (incorporating generative language models) yielded an increase in the average level of argumentative complexity, increasing from 3.04 to 3.47. This enhancement is interpreted as a sophistication of the logical-structural configuration of assertions and the incorporation of multivariate argumentation. The indicator of cognitive diversification demonstrated an increase from 2.88 to 3.49, signifying an expansion in the range of cognitive operations (classification, comparison, deduction, induction) catalyzed by heuristic AI recommendations.

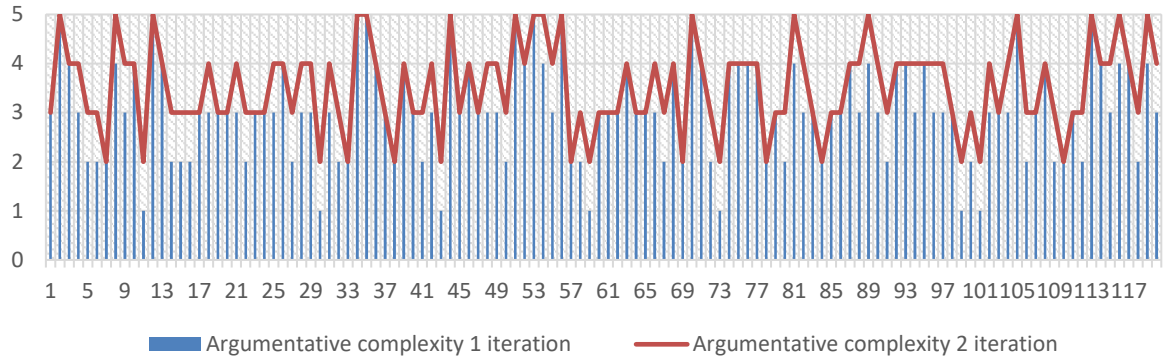

Figure 3. Results of inter-iterative comparative analysis according to the metric "Argumentative complexity"

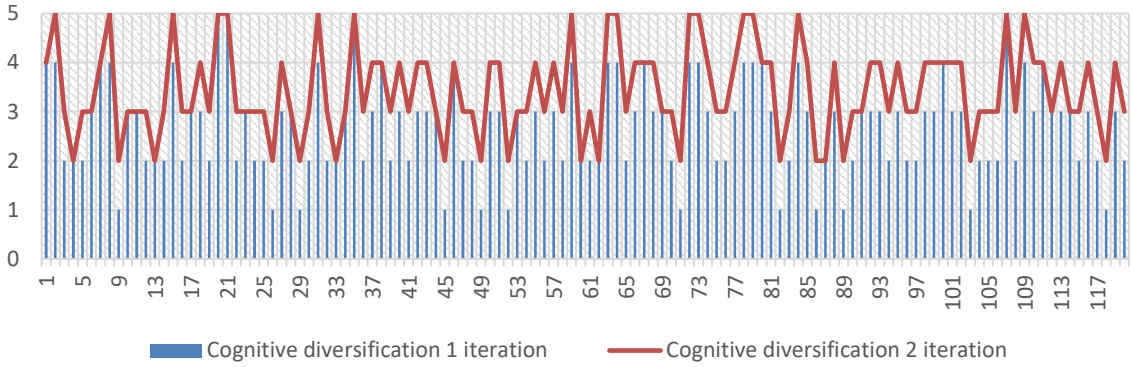

Figure 4. Results of inter-iterative comparative analysis according to the metric "Cognitive diversification"

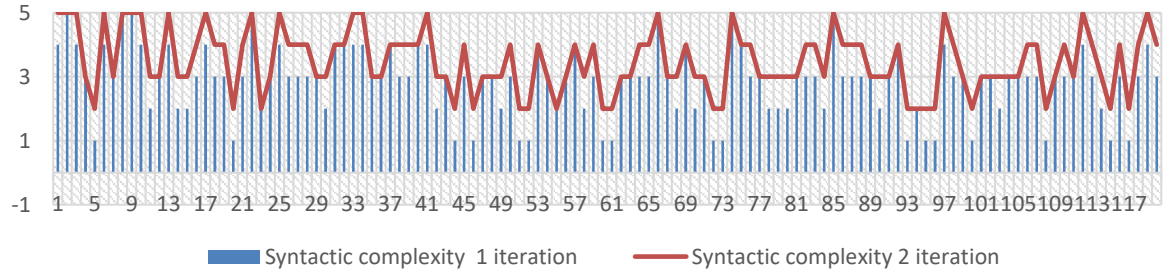

Figure 5. Results of inter-iterative comparative analysis according to the metric "Syntactic complexity"

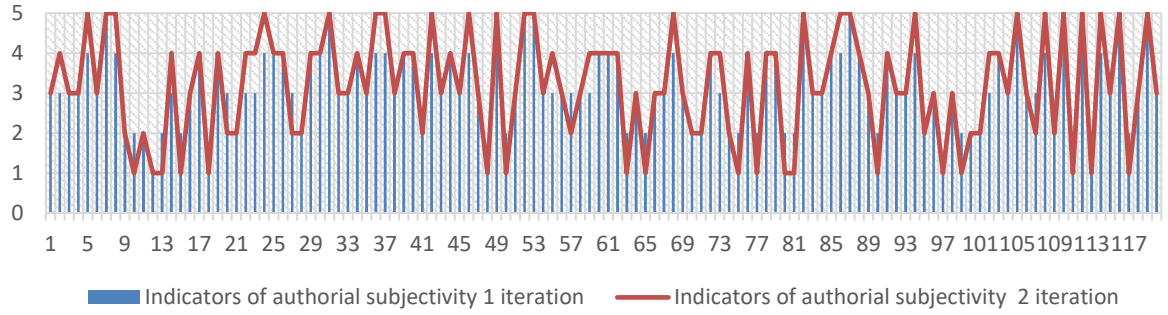

Figure 7. Results of inter-iterative comparative analysis according to the metric "Indicators of authorial subjectivity"

Figure 6. Results of inter-iterative comparative analysis on the metric "AI-discriminant weight"

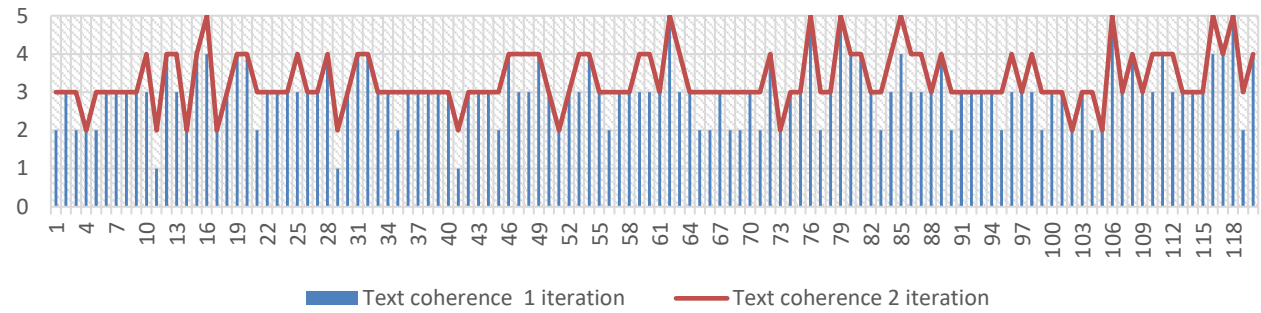

Figure 7. Results of inter-iterative comparative analysis according to the metric "Text coherence"

Syntactic complexity, as a metric indicative of the depth of nested grammatical constructions and the abundance of subordinate elements, increased from 2.89 to 3.45. This corroborates the enhancement of hierarchical depth within syntactic trees and the employment of compound structures featuring polylexemic constituents. At the same time, indicators of authorial subjectivity exhibited regressive dynamics, in particular a decline from 3.16 to 2.92. This can be signifying a reduction in the author's explicit self-positioning, a reduction in personalized references, and reflexive commentary, which have been partially replaced by machine-generated patterns.

The most pronounced delta fluctuation was observed in the AI-discriminant weight metric: the average rose from 17.90% in the initial iteration to 50.15% in the subsequent one. This underscores a substantial involvement of large language model (LLM) subsystems in the generative process, confirmed by algorithmic analysis via ZeroGPT and GPTZero. It is worth noting that in 68% of instances, the second iteration surpassed the threshold interval of >40%, indicating the presence of textogenic traces attributable to neural network processing.

Text coherence, evaluated through semantic consistency and logical continuity between discourse segments (utilizing sentence-BERT models and Coh-Metrix metrics), improved from an average of 3.01 to 3.45. This advancement is attributable to AI's algorithmic capacity to furnish a coherent pragmatic structure within the text through the integration of semantic replicas, albeit with a discernible tendency towards patterning.

In summation, the findings suggest that in academic writing AI functions as a cognitive amplifier, increasing the indices of formal complexity, cognitive variability, and textual coherence. At the same time, a variance in the author's presence is noted, posing a risk of diminishing the personal-reflective component inherent in academic writing. Therefore, within this research trajectory, the necessity for conducting an ethical and functional audit is substantiated. Notably, this takes place alongside the formulation of institutionally standardized protocols governing the acceptable utilization of AI in the realm of academic writing, predicated on principles of transparency, authorial integrity, and functional legitimacy,

To construct a variance model of AI integration within the academic writing process, undergraduates employed the outcomes of their self-reports compiled following the second iteration of the experiment. Through the questionnaire and expert validation, four levels of integrating the AI component into the essay structure have been delineated –

Table 2.

Table 2. Typology of levels of AI integration into text production

Level	Level Name	Characteristics of integration	Share among students (%)
I	Zero	AI was not used or was used exclusively for linguistic verification (grammar, punctuation).	12,5%
II	Fragmentary	AI is used to generate individual text fragments (introduction, conclusion) or lexical and stylistic substitutions.	31,7%
III	Synthetic	AI was used to build a logical and structural basis, argumentation, and the connection between paragraphs with the editorial.	39,2%
IV	Total	Full AI text generation with minimal user intervention (preferably stylistic adaptation or translation).	16,6%

Statistical characteristics:

- Weighted average level of AI integration (on a scale of 0–3): 1,60
- Variance (σ^2): 0,78
- Standard deviation (σ): 0,88

The results (

Table 2) illustrate a pronounced degree of variability in approaches pertaining to AI integration, attributable not only to distinct writing styles but also to the varying levels of digital ethical competence. The predominant mode observed is the synthetic level of integration (III), which underscores the supremacy of a hybrid approach – utilizing AI as a cognitive auxiliary tool, subsequently followed by editorial refinement and adaptation.

Although documented in a minority of cases, total generation is characterized by elevated AI-discriminant rates (>70%) and a notable decrease of authorial subjectivity, which poses a potential risk of eroding academic identity.

In light of the above, empirical variances corroborate the viability of developing a regulated scale for permissible AI integration, grounded in the principles of transparency, proportionality, and meaningful autonomy.

To formalize the evaluation of the variance in the instructors' attitudes towards the assimilation of generative AI within higher education, an expert survey was conducted employing the semantic differential scale (ranging from 1 – complete unacceptability to 5 – full support for integration) –**Error! Reference source not f ound.**.

Table 3. Typology of instructors' attitudes to AI generation in higher education

Level	Category name	Position characteristics	Share (%)
I	Rigorous criticism	Refusal to recognize any educational feasibility of AI due to the threat to academic integrity	9,5%
II	Conditional tolerance	Partial recognition of effectiveness under the condition of clear regulation, control and transparency of use	33,3%
III	Functional neutrality	Approval of AI as a technical tool in the absence of academic dependency	28,6%
IV	Adaptive support	Support for AI integration as a cognitive intermediary for optimizing writing and analytics	19,0%
V	Actively promoting innovation	Promoting the idea of using AI as a basic element of digital literacy in higher education	9,6%

Statistical parameters of the scale assessment (1–5):

- Average value (μ): 3,06
- Median: 3
- Mode: 3
- Variance (σ^2): 0,81
- Standard deviation (σ): 0,90
- Coefficient of variation (CV): 29,4%

The results (**Error! Reference source not found.**) elucidate a pronounced variance in expert p erspectives, signifying an epistemological fragmentation within the teaching community concerning generative AI. The preeminence of the categories "conditional tolerance" and "functional neutrality" suggests a predominantly

pragmatic orientation, wherein AI is perceived as an instrumental entity rather than an ontologically transformative force.

Rigoristic positions are increasingly marginalized, while adaptive methodologies are gradually garnering support, particularly among novice educators. In view of the above, this phenomenon establishes an epistemic foundation for the development of a soft-regulation policy concerning the integration of AI into educational frameworks. Notably, the teacher's role as a cognitive facilitator is being preserved.

Thus, when it comes to educators' perspectives, the divergence therein serves as a compelling indicator of the necessity for a structured professional dialogue and coherent principles governing the institutional incorporation of AI within higher education.

The synthesis of empirical findings from cognitive-oriented writing, utilizing generative AI tools, expert evaluations from educators, and students' self-reports regarding their level of technological assimilation has culminated in the establishment of a comprehensive framework titled "Artificial Intelligence as an Element of the Digital Culture of Contemporary Higher Education". The said framework is predicated on the principles of academic subjectivity, institutionalized ethical neutralization of AI modules, regulated utilization of generative potential, as well as the mitigation of didactic degradation. The framework's architecture encompasses regulatory stipulations, procedural integration protocols, and indicative preventive monitoring mechanisms (**Error! R eference source not found.**).

Table 4. Ontologically formalized framework for the use of AI as an element of the digital culture within modern higher education

Norm / Regulation	Description of the implementation logic	Description of the implementation mechanism	Expected effect
Normative legitimation of the use of AI in the context of academic writing	Determining the limits of the permissible use of LLM (Large Language Models) for generating texts, reviews, annotations, while maintaining the learner's cognitive autonomy	Development of a regulation on the academic ethics of digital authorship; self-reliance verification utilizing AI-detection tools (e.g., GPTZero, Turnitin AI, GLTR)	Preservation of academic integrity and authorial subjectivity; minimizing the risk of generative knowledge simulation
Hybrid model of cognitive collaboration "Human-AI"	Aimed at supporting critical thinking rather than fully delegating model's cognitive functions	Introduction of a mandatory post-generation revision stage with a built-in reflective module: student assessment of AI's contribution and their own role (e.g., questionnaires, structured descriptions)	Development of metacognitive reflection, increasing the cognitive complexity of tasks, formation of responsible use of generative AI
Ontological labeling of AI-engaged content	Ensuring transparency of text origin by semantic labeling of AI engagement	Mandatory inclusion of the "AI-involvement statement" section in the structure of written works; parametric gradation of AI participation (as a tool / as a co-author / as a source)	Strengthening digital trust, delineating copyright responsibility, developing digital transparency
Rubricative-discursive text evaluation with AI involvement	Instead of the conventional binary assessment of "acceptable/unacceptable," the implementation of a sophisticated rubric encompassing metrics of cognitive engagement, argumentative complexity, and logical as well as semantic coherence is advocated	Integration of an expert multi-level analytical rubric with level descriptors for each metric; automated support through NLP frameworks	Objectification of evaluating academic quality of texts incorporating elements of AI assistance; enhancement of feedback quality
Contextualized AI digital ethics training	Incorporating AI Ethical and legal awareness components into research methodology, academic	Development of an interdisciplinary module "Digital AI Literacy & Ethics" with case analysis,	Cultivating students' value orientation towards artificial intelligence as a cognitive, rather than a

Norm / Regulation	Description of the implementation logic	Description of the implementation mechanism	Expected effect
	writing, training courses on the Philosophy of Science	scenario modeling, discursive reflection	substitutionary agent; mitigating the risk of technological infantilization
Monitoring cognitive regression in the use of AI	Systematic observation of the potential decrease in the capacity for autonomous knowledge production	Regular format audit of learning outcomes with cognitive complexity metrics (Gunning Fog Index, Depth of Reasoning, NLP-based Taxonomy Mapping)	Prevention of cognitive atrophy, ensuring adaptive adjustment of AI integration policies

Thus, the ontologically formalized framework (**Error! Reference source not found.**) delineates a s tructured system of normative, cognitive-heuristic, and regulatory-instrumental components. These elements facilitate the seamless integration of generative AI agents into the digital culture of higher education, thereby mitigating institutional entropy. It embodies the principles of non-delegated cognition, semantic traceability, subject-attributed accountability, and epistemic transparency. Within the framework of this study, these principles are critically essential to mitigate the functional devaluation of academic pursuits in the face of the escalating prominence of LLM systems.

The transdisciplinary adaptation of educational policies is imperative for the implementation of this framework. It can be achieved through mechanisms of policy stratification, cognitive oversight, meta-assessment of authorship, and the modulation of ethical considerations regarding artificial intelligence. The anticipated outcomes encompass an enhancement of students' cognitive resilience, stabilization of argumentative complexity and logical-semantic coherence, a diminishment of the risk of cognitive atrophy. Furthermore, there is an emphasis on the cultivation of normative and ethical standards of digital responsibility within the academic environment.

In addition, practical recommendations are advanced to facilitate actionable integration of the framework within higher education. Educators are encouraged to introduce structured training on balanced and ethical AI engagement, develop assessment rubrics incorporating indicators of argumentation, coherence and authorial subjectivity, and implement reflective self-declarations of AI involvement to sustain cognitive autonomy. Administrators are advised to redesign curricula to embed AI-supported activities into digital literacy and academic skills courses, establish institutional policies defining permissible versus prohibited practices, and deploy longitudinal monitoring systems to track cognitive, normative and performance indicators. Policymakers are urged to develop sector-wide ethical AI protocols, fund capacity-building programs to upskill faculty in digital pedagogy, and promote cross-institutional pilot projects with longitudinal follow-up to observe sustained effects on writing development, critical thinking and academic integrity. Together, these measures enhance the replicability, scalability and ethical resilience of the proposed framework across diverse institutional contexts.

As evidenced by the empirical findings, the observed cognitive-discursive shifts have direct implications for learning processes, demonstrating that generative AI can amplify structural clarity, compositional coherence, and analytical depth factors positively associated with improved learning outcomes and higher-order reasoning. These transformations underscore the potential of AI-assisted writing tasks to function as scaffolding mechanisms that strengthen students' metacognitive regulation, argumentation strategies, and discourse organization when integrated under controlled, pedagogically aligned conditions. Building on this, instructors may employ the identified cognitive parameters argumentative complexity, diversification, syntactic structuring, and authorial subjectivity as operational anchors for instructional design, embedding AI-supported drafting, feedback cycles, and self-reflective authorial audits into the architecture of learning activities. Furthermore, the proposed framework can be pragmatically translated into classroom practice through structured AI-involvement declarations, tiered assignment designs distinguishing autonomous and assisted stages, and policy-aligned assessment models that trace cognitive contributions. At the institutional level, the framework informs campus-wide governance by offering explicit criteria for permissible AI engagement, enabling evidence-based policy formation, adaptive curricular redesign, and the alignment of AI use with educational quality assurance standards.

Within the framework of this section, an analytical discourse and review of pertinent publications are conducted to juxtapose conceptual, empirical, and normative methodologies regarding the integration of generative artificial intelligence into higher education. The focus is placed on validating the alignment of the findings from the current study with prevailing trends, practices, and regulatory models delineated in related academic literature.

McDonald, Johri, Ali, and Collier [42] elucidated the preeminence of the regulatory-directive paradigm regarding the integration of GenAI within R1 universities in the United States. This supremacy is characterized by a predominance of text-centric methodologies, unstructured ethical declarations, as well as homogenization of content for educational approbation. In contrast, the present study posits an ontologically formalized framework

comprising stratified cognitive-normative modules, which facilitates semantic traceability, cognitive non-delegation, and adaptive subjective accountability in the application of GenAI.

Further and Holcombe [43] incorporated GenAI as an illustrative-interpretive module within a linguodidactic framework, emphasizing presentational outputs and ethical attribution. Instead, through the lens of academic writing within a higher education system, this study implements the framework of cognitively stratified GenAI integration underscored by regulatory oversight, cognitive traceability, and rubric-based verification.

It is noteworthy that a PRISMA review was conducted by Chanpradit [44], elucidating the cognitive advantages of GenAI (coherence, lexical variability) alongside the risks of generative simulation, ethical opacity, and unequal access. The current study transposes these elements into a framework for normatively stratified GenAI integration, concentrating on cognitive traceability, rubric-based verification, and digital ethics.

Next, in Floridi's research [45] Content Studies are conceptualized as a transdisciplinary response to the phenomenon of algorithmic content genesis, amalgamating multimodal analytics, ethical-design modeling, and cognitive-semiotic interpretation. Conversely, the present study employs a regulatory and ontological framework for integrating GenAI into the academic textual genesis, emphasizing cognitive non-delegation, semantic traceability, and rubricative verification.

According to Safii, Hadi & Harahap [46], GenAI is characterized as a discursive cognitive mediator that elucidates the transformations of linguistic identity among students in the process of literary interactions. In contrast, this study examines GenAI as a cognitive stratification instrument within academic writing, concentrating on regulatory governance, subject-labeled accountability, and rubricative assessment.

What is more, the researchers Ansone, Zālīte-Supe & Daniela [47] explored GenAI as a conceptual-heuristic resource within art education, underscoring its potential as a generator of ideas, albeit constrained by precise aesthetic embodiment. In the current study, GenAI is represented as a cognitive-institutional component of academic writing within the higher education framework, structured through normative traceability, subjective accountability, and semantic stratification of cognitive interactions.

Interestingly, Uttich, Yee & Giltner [48] conceptualized the ramifications of GenAI as a destabilizing influence on traditional assessment methodologies, particularly in writing assignments. The scholars propose adaptive strategies that incorporate GenAI to preserve academic complexity and foster critical thinking. In contrast, the present study establishes an institutional-cognitive framework that formalizes the conditions for the normative integration of GenAI in academic writing, thereby ensuring cognitive autonomy, subjective accountability, and ethical traceability.

A noteworthy linguosemiotic analysis of the author's voice in academic texts was conducted by Nañola et al. [49], elucidating the preeminence of the collective (C) voice in student essays as opposed to the individual (I) voice in GenAI compositions. In the above study, the predicativity and expertise inherent in AI stylistic was underscored. Conversely, the present study is centered on the formulation of a framework for the cognitive identification of text production, wherein authorial subjectivity is evaluated through multifactorial metrics (coherence, creativity, AI-discriminant weight) that trace the role of AI in the genesis of knowledge.

Rodafinos [50] posited GenAI as a cognitive accelerator in research writing, accentuating the enhancement of argument formation, thesis structuring, and critical verification of results. The current study extends this paradigm by proposing an institutionalized framework for the cognitive-ethical integration of GenAI, encompassing ontological labeling, normative stratification, and rubricative evaluation of academic output.

Jaboob, Al-Ansi & Riyadh [51] systematized trends in the incorporation of AI within higher education, concentrating on the personalization of learning, automation of assessment. Accordingly, the ethical risks and challenges associated with infrastructural and personnel dimensions were considered in the said research. In contrast, the present study formalizes a normative-value framework for the integration of GenAI, featuring cognitive stratification, semantic traceability, and mechanisms designed to preserve academic subjectivity within the educational environment.

Against the backdrop of the above analysis, the discussion and synthesis elucidate that the current study conceptually embodies the transition from fragmented or heuristically oriented models of GenAI application in higher education to a systematically formalized normative-cognitive architecture. The proposed framework offers semantic traceability of AI influence, cognitive non-delegation, subject-marked accountability, and rubricative verification of academic performance. Thus, it thereby distinguishes this study from existing methodologies through its depth of stratification, ontological formalization, and institutional adaptability [52]-[54].

The scientific novelty of this study resides in the development of an ontologically formalized framework for the integration of artificial intelligence into the higher education system. The latter amalgamates cognitive traceability, epistemic transparency, subject-labeled responsibility, and normative stratification. The proposed model facilitates systematic coordination among technological mediation, ethical guidelines, and educational outcomes within the context of digital transformation.

The practical implications of the study's findings lie in the development of tools for institutional regulation, cognitive monitoring, and adaptive integration of artificial intelligence into the educational environment. The results can be used to devise regulations for digital interaction, ensuring a harmonious balance

between automation and subjectivity. Moreover, a sustainable regulatory and ethical framework for higher education can be established.

The overriding limitation of this study lies in the absence of empirical validation of the developed framework within a genuine educational environment characterized by dynamic cognitive-pedagogical variables. This deficiency precludes the assessment of its operational efficacy, regulatory resilience, and institutional scalability amid a diverse array of academic practices.

Furthermore, the study's reliance on AI-discriminant tools (GPTZero, ZeroGPT) introduces an additional constraint. Although these instruments were employed to detect algorithmic traces in academic writing, they are inherently subject to biases, reliability fluctuations, and evolving algorithmic architectures. Such tools may yield false positives (misclassifying human-written texts as AI-generated) or false negatives (failing to detect AI-assisted segments), thereby affecting the accuracy of subjectivity and authenticity metrics. Acknowledging these methodological uncertainties underscores the need for a critical and reflexive stance toward detection technologies and highlights the necessity of triangulating results with expert-coded assessments and student self-reports to ensure higher validity.

The limitations of this study can be further reinforced to reflect a higher degree of methodological awareness within the context of educational research. Beyond the absence of in situ empirical validation and the constraints associated with AI-discriminant detection tools, the study is also bounded by the controlled experimental design, which while enabling precise measurement of cognitive-discursive shifts cannot fully capture the complexity of real instructional dynamics, heterogeneous pedagogical practices, and authentic student–teacher interactions. The reliance on a single institutional context limits cross-institutional generalizability, as cognitive, cultural, and policy environments may differ substantially across higher education systems. Moreover, the study focuses primarily on short-cycle writing tasks, which may not fully represent long-term learning trajectories, higher-order competence formation, or deep epistemic engagement. These constraints collectively highlight the need for multi-site validation, longitudinal tracking, and integration of richer pedagogical variables to strengthen the robustness, ecological validity, and transferability of the findings in future research.

It is expedient to conduct empirical evaluations of the framework within the context of a pilot implementation at a higher educational institution, documenting cognitive-behavioral, normative, and productive indicators. Based on these findings, it is advisable to develop regulatory and methodological recommendations for the broader application of the framework, accounting for institutional specificities and digital infrastructure. In addition, a longitudinal follow-up study is recommended to observe the sustained effects of AI integration on the same cohort of students across multiple semesters. Such an approach would enable the tracking of long-term dynamics in writing development, critical thinking, ethical engagement, and academic integrity, thereby capturing processes of adaptation, habituation, and potential cognitive shifts. This would enhance the explanatory power of the framework and ensure its validity for long-term educational transformation.

4. CONCLUSION

The inter-iterative comparative analysis confirmed statistically significant gains in argumentative complexity (+14.1%), cognitive diversification (+21.2%), syntactic complexity (+19.4%), and coherence (+14.6%) under generative AI influence, alongside a decline in authorial subjectivity (−7.5%) and a sharp rise in AI-discriminant weight (+180.2%), evidencing risks of cognitive overdelegation, with 16% of students demonstrating total AI generation and instructors showing polarized acceptance (9.5%–9.6%). In response, an ontologically stratified framework was formalized to ensure cognitive non-delegation, semantic traceability, and subject-labeled accountability, enabling universities to operationalize regulated AI use through AI-involvement declarations, rubric-based assessment, embedded AI-literacy modules, and longitudinal cognitive monitoring to stabilize academic agency and preserve pedagogical integrity.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried **out** entirely by the authors without the assistance of AI-based technologies.

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