

Artificial Intelligence and academic writing in higher education: a comparative analysis of linguistic indicators in student texts (2023–2025)^I

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Abstract

This exploratory comparative study analyzes linguistic indicators associated with the use of Artificial Intelligence (AI) in academic texts produced by higher education students. The corpus consisted of four papers selected through simple random sampling from a set of ten academic assignments. The analysis was conducted using a qualitative matrix composed of three categories: language and style, textual structure, and markers of authorship. These categories were operationalized through the identification of weak, moderate, or strong indicators of the presence or absence of such characteristics in the texts. The results revealed relevant differences between the analyzed papers: texts produced in 2023 showed greater stylistic variation, the presence of authorial markers, and irregularities typical of human writing, whereas texts from 2025 presented a higher concentration of indicators associated with linguistic standardization, structural uniformity, and a reduction of individual markers of authorship. Additionally, excessively concise and generalized explanations with limited conceptual depth were observed. The findings highlight the need to promote pedagogical practices in higher education that encourage the critical, ethical, and reflective use of AI in academic writing.

Keywords: Artificial Intelligence; higher education; digital technologies; learning.

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Inteligência Artificial e escrita acadêmica no Ensino Superior: análise comparativa de indícios linguísticos em produções estudantis (2023–2025)

Resumo

Este estudo exploratório comparativo analisa indícios linguísticos associados ao uso de Inteligência Artificial (IA) em produções acadêmicas de estudantes do Ensino Superior. O corpus foi composto por quatro trabalhos selecionados por amostragem simples a partir de um conjunto de dez produções acadêmicas. A análise foi conduzida por meio de uma matriz qualitativa composta por três categorias: linguagem e estilo, estrutura textual e marcas de autoria, operacionalizadas a partir da identificação de indícios fracos, medianos ou fortes de presença ou ausência dessas características nos textos. Os resultados indicaram diferenças relevantes entre os trabalhos analisados: produções de 2023 apresentaram maior variação estilística, presença de marcas autorais e irregularidades típicas da escrita humana, enquanto textos de 2025 concentraram maior número de indícios associados à padronização linguística, uniformidade estrutural e redução de marcas individuais de autoria. Também foram observadas explicações excessivamente sintéticas e generalistas, com baixo aprofundamento conceitual. Os resultados reforçam a necessidade de promover, no Ensino Superior, práticas pedagógicas voltadas ao uso crítico, ético e reflexivo da IA na escrita acadêmica.

Palavras-chave: Inteligência Artificial; Ensino Superior; tecnologia digitais; aprendizagem.



Inteligencia Artificial y escritura académica en la educación superior: análisis comparativo de indicios lingüísticos en producciones estudiantiles (2023–2025)

Resumen

Este estudio exploratorio comparativo analiza indicios lingüísticos asociados al uso de IA en textos académicos producidos por estudiantes de educación superior. El corpus estuvo compuesto por cuatro trabajos seleccionados mediante muestreo aleatorio simple a partir de un conjunto de diez producciones académicas. El análisis se realizó a través de una matriz cualitativa compuesta por tres categorías: lenguaje y estilo, estructura textual y marcas de autoría, operacionalizadas mediante la identificación de indicios débiles, moderados o fuertes de la presencia o ausencia de dichas características en los textos. Los resultados revelaron diferencias relevantes entre los trabajos analizados: las producciones de 2023 presentaron mayor variación estilística, presencia de marcas autorales e irregularidades típicas de la escritura humana, mientras que los textos de 2025 concentraron un mayor número de indicios asociados a la estandarización lingüística, la uniformidad estructural y la reducción de marcas individuales de autoría. También se observaron explicaciones excesivamente sintéticas y generalistas, con escasa profundización conceptual. Los resultados resaltan la necesidad de promover, en la educación superior, prácticas pedagógicas orientadas al uso crítico, ético y reflexivo de la IA en la escritura académica.

Palabras clave: Inteligencia Artificial; educación superior; tecnologías digitales; aprendizaje.



Introduction

Recent advancements in generative Artificial Intelligence (AI) tools have prompted significant transformations in how higher education students produce academic texts (Azambuja; Silva, 2024; Guerra et al., 2024). Broadly defined, AI constitutes a field of Computer Science dedicated to developing systems capable of operating in a manner similar to human intelligence, particularly in language pattern recognition and in supporting decision-making and learning.

Among its applications, Natural Language Processing (NLP) stands out, enabling computational systems to understand and produce human language. Within this framework are chatbots such as ChatGPT, which are based on Large Language Models (LLMs) and structured from deep learning architectures—such as transformer models—capable of generating cohesive and coherent texts (Gomes, 2010; Mendonça et al., 2023; Sobreira, 2025).

In the educational sphere, these systems have been widely utilized to assist students in completing exercises, producing texts, and obtaining personalized explanations. The ease of access and the efficiency of the responses have contributed to the incorporation of these tools into study practices across various levels of education.

While this scenario expands possibilities—such as access to information and writing support—it simultaneously raises concerns regarding technological dependence and the potential weakening of fundamental skills, including critical reading, reflection, and the autonomous resolution of complex problems.

Recent studies (2024–2025) have investigated the use of AI by students, discussing its impacts on learning and academic production (Gerlich, 2025; Zhai; Wibowo; Li, 2024). However, a large portion of this research focuses on perceptions or theoretical analyses; studies examining the linguistic and structural characteristics of student-produced academic texts, as well as comparisons between productions prior and subsequent to the popularization of these tools, remain scarce.



Within this context, the present study analyzes academic papers produced by undergraduate students in a course within the Biological Sciences field at a private higher education institution located in Southern Brazil.

Thus, this study aims to analyze indicators of AI mediation in academic texts, comparing productions from 2023 and 2025 to identify potential transformations in writing and discuss their implications for higher education. It is important to emphasize that identifying the use of AI does not constitute the primary objective of this study, nor do tools exist that can guarantee such identification with absolute precision. The analysis focuses on observable qualitative indicators within the texts, which allow for reflection on changes in written production and their pedagogical implications.

Methodology

This study is characterized as qualitative, exploratory, and comparative research (Gil, 2002), focused on identifying and describing linguistic and textual indicators of potential Artificial Intelligence (AI) tool utilization in academic papers produced by higher education students. The corpus comprises four academic papers written by students from the same institution, within the same course, covering the same syllabus content, and evaluated under the same assessment rubric, but across different terms: 2023/2 and 2025/2. Although the number of texts is limited, the research assumes an exploratory character, seeking to identify initial patterns and formulate hypotheses regarding potential indicators of AI mediation in academic textual production.

The selection of texts followed three criteria: i) year of production, with two papers from 2023 and two from 2025, representing periods with distinct levels of exposure to AI tools; ii) comparability, ensuring equivalence regarding structural layout, instructions, pedagogical objectives, and evaluative criteria; iii) selection procedure: initially, ten papers produced within the same evaluative activity were considered, from which those with the highest grades were selected. Among these high-scoring papers, a draw was conducted via



simple random sampling, selecting two texts from each year to compose the final corpus.

The texts were converted into .pdf format and numbered (T1 to T4). Subsequently, a comprehensive reading and segmentation into units of analysis were performed in dialogue with the assumptions of content analysis, which conceives categorization as an interpretative process guided by theoretical frameworks and the researcher's perspective (Bardin, 2006).

Textual analysis was based on parameters derived from the literature on the detection of AI-generated writing (Spinak, 2023; Toledo, 2025), as well as accumulated instructional observations.

The definition of the analytical criteria also dialogues with Applied Linguistics and Discourse Analysis, which conceive the text as a situated and heterogeneous social practice, marked by conditions of production and traits of authorship (Marcuschi, 2008; Orlandi, 2009). In this sense, indicators such as lexical variation, irregularity of fluidity, the presence or absence of authorial markers, and the degree of structural standardization were interpreted as discursive manifestations rather than merely formal aspects. This perspective underpins the qualitative analysis adopted, in which the identification of indicators involves interpreting patterns of regularity and linguistic homogenization potentially associated with the use of generative AI.

The analytical categories were organized into a structured protocol, divided into blocks and presented in Chart 1, in which each criterion was coded regarding its presence or absence in the analyzed texts.



Chart 1 – Protocol with established categories for the analysis of papers T1 to T4

Analysis Block	Weak Indicators	Moderate Indicators	Strong Indicators
Language and Style	stylistic variations throughout the text; presence of some typos, spelling, or agreement errors; irregular fluidity: longer sentences alternated with short ones; varied vocabulary, but without rigid standardization; irregular lexical repetitions.	perfect spelling, but with minor inconsistencies in style; sentences that are too short or excessively clear; absence of errors combined with overly simple vocabulary; minimal lexical variations, but still present; neutral tone.	“perfect” and consistently neutral vocabulary; artificially fluid; paragraphs with an almost identical number of sentences; total lexical uniformity (scarce synonyms, standardized repetitions); texts that appear overly “pedagogical.”
Textual Structure	moderate use of bullet points/lists when relevant, interspersed with more descriptive patterns; simple and linear organization; paragraphs with natural variation (2–6 sentences); basic transitions between ideas (however, meanwhile, furthermore).	predominance of bullet points (lists become the standard organization); paragraphs that are too short (1–2 sentences); repetitive structure between sections; lack of transitions (leaping from one paragraph to another).	all parts follow the same sentence structure “model”; sections with a rigid pattern (same size, same format, same cadence); signs of a prompt template (“introduction:...”, “objectives:...”, all identical); highly uniform cadence.
Markers of Authorship	variations in style typical of a student; insertion of personal opinions, stances, and judgments; use of individualized expressions (“I consider that...”, “in my view...”); natural inconsistencies: mixing up verbs.	overly neutral/polite tone, but still with minor traces of a personal voice; highly pedagogical explanations; generic references to authors (“according to studies...” without specification); lack of particularity in the argumentation.	total disappearance of personal voice or individual traits; homogeneous tone throughout the entire text; flawless, generalized explanations that read like an AI summary; examples that are too “clean” and overly formal.

Source: Elaborated by the authors (2025)

The descriptors presented at each intensity level (weak, moderate, and strong) functioned as interpretative parameters, guiding the identification of recurring patterns during the analytical reading of the papers. Therefore, they



are not cumulative independent indicators, but qualitative characterizations of the intensity of the signs.

The criteria presented in Chart 1 were operationalized through an analytical reading of the texts, identifying the presence or absence of each linguistic or structural characteristic described in the matrix. The occurrence of these elements was recorded dichotomously (present/absent), allowing the systematization of the results into a comparative matrix. Subsequently, an intergroup comparison was conducted, seeking to identify patterns that distinguished the 2023 and 2025 productions in relation to the analyzed criteria.

For systematization purposes, each identified occurrence received a unit value, and the total number of indicators per paper was tallied. No differentiated weights were assigned to the categories, considering the exploratory nature of the research, which was aimed at identifying general patterns rather than the statistical measurement of the phenomenon.

The analyzed papers were anonymized to preserve the students' identities. The study did not involve intervention, primary data collection, or direct contact with human participants; thus, in accordance with Resolutions No. 510/2016 and No. 580/2018 of the National Health Council, it qualifies as research that does not require review by a Research Ethics Committee (CEP), as it exclusively utilizes pre-existing institutional documents.

To support the elaboration of Chart 1, ChatGPT (free version) was used to list and summarize potential signs of AI use, contributing to the initial construction of the analytical matrix. The tool was also employed as support for organizing ideas in the Results and Discussion sections, without replacing the analysis, interpretation, or writing of the data by the authors. The interactions were conducted based on the Generated Knowledge Prompting technique, which consists of the prior generation of knowledge to enhance the quality of responses from language models (Liu et al., 2021).

To mitigate potential biases and avoid methodological circularity, it is emphasized that the use of ChatGPT was exclusively auxiliary. The descriptors



were consolidated from a theoretical review and the interpretive validation of the researcher, rather than being automatically derived from the tool.

Results

Two papers produced in 2023 were analyzed, a period corresponding to the initial popularization of GPT-type generative AI tools, when both the quality of the responses and the students' familiarity with this type of resource were still incipient. Additionally, two papers produced in 2025 were analyzed, a period in which students demonstrated greater familiarity with these tools, alongside a higher refinement of the systems regarding human communication patterns.

The 2023 papers were identified as T1 and T2, while those from 2025 were identified as T3 and T4. All analyzed papers consisted of the development of a Degraded Area Recovery Protocol, proposed by the same professor in both years. Furthermore, they followed the same textual production guidelines defined in the evaluative activity. Thus, although produced with a two-year interval, the texts present an equivalent structure, composed of the following elements: identification of the degraded area; identification of the degradation processes; identification of the soil type; description of the recovery methods; selection and identification of tree species; and description of their uses in the degraded area. The four papers were evaluated based on the same rubric and developed in teams of four to six students.

In the individual analysis of each paper, the presence or absence of each category described in Table 1 was verified. The evidence was classified into three levels: weak, when presenting a low incidence of characteristics associated with AI use; moderate, when presenting an intermediate occurrence; and strong, when presenting more prominent characteristics, with this level being interpreted as a possible intensive use of the tool. For each identified indication, its occurrence was recorded dichotomously (present/absent). The results of this analysis are presented in Table 1.



Table 1 – Results of the analysis of the presence or absence of indicators in the analyzed papers.

Language and Style				
Evidence	T1	T2	T3	T4
Weak	4	5	1	0
Moderate	1	1	4	2
Strong	0	0	5	5
Textual Structure				
Evidence	T1	T2	T3	T4
Weak	4	4	1	0
Moderate	0	0	4	4
Strong	0	0	3	3
Authorial Markers				
Evidence	T1	T2	T3	T4
Weak	4	4	1	0
Moderate	0	0	3	2
Strong	0	0	4	4

Source: Elaborated by the authors (2025).

Table 1 presents the quantity of indicators identified in each paper based on the descriptors defined in the analytical matrix. The values represent the frequency of characteristics observed in the texts rather than a fixed maximum score, given that the descriptors function as qualitative parameters of intensity.

It is observable that papers T1 and T2 presented a higher number of indicators classified as weak, totaling 12 and 13 occurrences, respectively (Figure 1). In contrast, papers T3 and T4 presented only 2 and 0 indicators in this category, respectively. This reduction may indicate a greater presence of characteristics associated with linguistic and structural standardization, frequently discussed in the literature as potential signs of mediation by generative AI tools.

In Figure 1, excerpts highlighting markers of authorship as well as occurrences of punctuation irregularities are distinguished in red—aspects that reinforce the classification of these texts as carrying weak indicators of AI mediation.



Figure 1 – Weak indicators present in Paper T1. In red, markers of authorship and a lack of punctuation are noticeable in various parts of the excerpt.

Foi identificada a presença de duas espécies invasoras no CEAEC, a formiga cortadeira (*Attini sp*) e o cupim arbóreo (*Nasutitermes corniger*). Em entrevistas feitas no projeto anterior houve relatos que foram feitas tentativas anteriores de controle natural para reduzir ambas as populações, porém, sem sucesso, resultando na persistência dessas pragas no local onde se encontra em todos os entornos da área do CEAEC.

Source: Elaborated by the authors (2025).

Regarding indicators classified as moderate, papers T1 and T2 presented 1 and 1 occurrence, respectively. Conversely, papers T3 and T4 obtained 11 and 8 indicators in this category, respectively.

Paper T3 presented a higher number of indicators classified as moderate, possibly because it still retained the presence of some grammatical errors and greater vocabulary variation in certain portions of the text, as exemplified in Figure 2. These characteristics may indicate an intermediate level of linguistic standardization, in which elements associated with human writing coexist with traits that, in the literature, have been discussed as potential indicators of mediation by generative AI tools.

Figure 2 – Excerpt from paper T3, indicating moderate signs of AI use. A lack of a comma and the inappropriate use of a period are noticeable in item two, between the words “local” and “fazendo”.

A extração de argila leva a uma supressão da mata nativa, assim ocasionando uma série de impactos. A retirada da cobertura leva a uma grande ou total perda de vegetação local, assim eliminando a complexidade local. Fazendo com que espécies de animais nativos saiam do local. deixando o solo desprotegido. ficando exposto à ação da chuva e do vento, tornando-se mais vulnerável à erosão. Outro impacto é a formação de áreas alagadas com a mineração se forma valas e buracos, sem um plano de drenagem correto

Source: Elaborated by the authors (2025).

In the excerpt, it is possible to notice a lack of a comma and the use of a period in an inappropriate place, in item two, between the words “local” and “fazendo”, as well as the use of simpler language, with style variations typical of



student writing and irregular textual fluidity. These elements correspond to the characteristics described for indicators classified as moderate in the analytical matrix, indicating an intermediate level of linguistic standardization.

Regarding indicators classified as strong, papers T1 and T2 presented 0 and 0 occurrences in this category, respectively. On the other hand, papers T3 and T4 registered 12 and 12 indicators classified as strong, respectively. Figures 3 and 4 present examples of excerpts that illustrate some of these characteristics identified in the analyzed texts.

Figure 3 displays two distinct paragraphs extracted from the same paper (T4). A similar number of lines is observed in each paragraph, as well as a similar compositional structure, beginning with a conceptualization, followed by a problematization, and concluding with a summary. The text presents a neutral and polite tone, with discursive detachment, an absence of personal examples, and an absence of grammatical errors. Furthermore, the writing pattern shows little variation throughout the assignment, remaining relatively homogeneous across different sections of the text.

Figure 3 – Excerpts from paper T4 with signs of excessive AI use. A: excerpt found in paper T4 on page five, describing the Atlantic Forest biome; B: excerpt found in paper T4, page seven, describing the characteristics of the Red Latosol soil type.

A	A Mata Atlântica é um dos biomas mais ricos em biodiversidade do mundo,	1
	hospedando um grande número de espécies originais, ocupa cerca de 1,3 milhão de km ² ,	2
	mas hoje restam apenas 8% da própria. Apesar da intensa e incessante degradação	3
	continua desempenhando funções essenciais, como regulação do clima, nascentes de água	4
	natural fazendo a manutenção e irrigação do solo, é considerada um hotspot mundial de	5
	biodiversidade e recebe proteção especial pela legislação brasileira.	6

B	O solo predominante na área é classificado como Latossolo Vermelho distrófico	1
	(LVd), caracterizado por textura argilosa, boa drenagem e baixa fertilidade natural.	2
	Apresenta estrutura granular e alta profundidade, porém com sinais de compactação	3
	superficial devido ao uso agrícola intensivo e tráfego de maquinário. O subsolo mostra-se	4
	medianamente permeável, favorecendo escoamento superficial e risco de erosão em	5
	períodos chuvosos.	6



Source: Elaborated by the authors (2025)

Figure 4 allows for the observation of differences in textual organization between the analyzed papers. Paper T1 presents a construction based on paragraphs of varying sizes and with a predominantly descriptive character, while paper T3 demonstrates a textual organization structured primarily in bullet points, with shorter sentences and synthetically presented ideas. According to the criteria of the analytical matrix, paper T1 presented a higher occurrence of indicators classified as weak, while paper T3 concentrated a larger number of indicators classified as strong.

In the intergroup analysis, when examining the total indicators of AI use across the two analyzed periods (2023 and 2025), a contrasting scenario between the years is observed. Figure 5 aids in visualizing this pattern, showing an inverse trend in the distribution of the different levels of indicators between the papers produced in each period.

Figure 4 – Excerpts from paper T3 with indicators of AI use. A: T1 – produced in 2023, with language characteristics typical of human writing; B: T3 – produced in 2025, with indicators typical of AI-generated language.

7.4.4. ADUBAÇÃO VERDE

A adubação verde é uma prática agrícola que utiliza plantas capazes de reciclar nutrientes do solo e da atmosfera, tornando-o mais fértil e produtivo. Para essa área, o nabo-forrageiro (*Raphanus sativus* L.) é uma escolha sugerida, pois suas raízes auxiliam na descompactação do solo, na ciclagem de nutrientes como nitrogênio e fósforo, e pode ser usado para consumo humano. Além disso, contribui para a Fixação Biológica do Nitrogênio (FBN) por meio de associações com bactérias diazotróficas.

7.4.5. PLANTIO

O espaçamento recomendado entre linhas é de 20 cm a 40 cm. Quando o objetivo é a produção de grãos, o espaçamento deve ser maior. Utilize em média 25 sementes por metro linear, com uma faixa de 3 kg/ha a 15 kg/ha, dependendo do sistema de semeadura (lanço ou plantadeira).

7.4.6. CRESCIMENTO DA CULTURA

Para o plantio, indica-se um espaçamento entre linhas de 20 cm a 40 cm, porém, quando o objetivo é a produção de grãos, o espaçamento deve ser maior. São usadas, em média, 25 sementes por metro linear, com um gasto de 3 kg/ha a 15 kg/ha, dependendo do sistema de semeadura, que pode ser feito a lanço ou por plantadeiras (Embrapa,s.d.).

A - T1

(Continued)



(Continued)

Materiais e insumos

- Mudas conforme a tabela;
- Grama-tuim;
- Sacos de fibra de coco, pedras locais, estacas, corda e ferramentas (cavadeira, enxadão, marreta).
- Adubo orgânico (composto/esterco curtido);
- Estacas de marcação e placas de sinalização.

Sequência de execução

1- Proteção, marcação e delimitação (Dia 0–5)

- Cercar o perímetro, sinalizar e demarcar com coordenadas as áreas a ser aplicada cada tipo de controle.

2 - Limpeza e preparo (Dia 4–10)

- Capina seletiva de invasoras;
- Descompactar taludes e fundo de sulcos;
- Adubação orgânica local: (composto/esterco curtido) + cobertura morta.

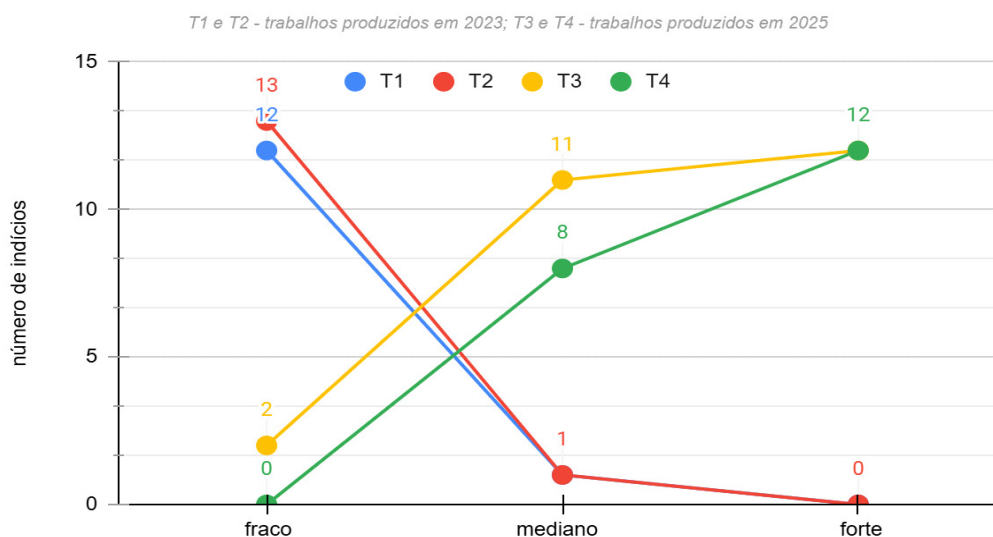
B - T3

Source: Elaborated by the authors (2025).

When analyzing Figure 5, while in 2023, papers T1 and T2 presented characteristics associated with student writing—such as grammatical errors, the presence of authorial markers, and variations in textual organization, with paragraphs of distinct sizes and lexical variation typical of academic writing in development—papers T3 and T4 concentrated a higher number of indicators classified as moderate and strong.



Figure 5 – Comparison of AI indicators in papers produced in the years 2023 and 2025.



Source: Elaborated by the authors (2025)

These texts evidenced characteristics frequently associated with writing mediated by AI tools, such as greater uniformity in textual cadence, paragraphs with similar structures, recurrent use of organization in bullet points, and a lower incidence of individual markers of authorship.

Discussion

Currently, AI tools assist students in completing exercises, planning studies, and drafting academic texts, among other activities. Figure 5 presents indicators of AI use that contrast between the years 2023 and 2025, suggesting a significant increase in the utilization of these tools in the more recent period. This pattern may indicate a greater incorporation of generative tools by higher education students, which raises questions about potential impacts on academic textual production, including a reduction in informational depth in some cases.

This growth in the use of AI tools is also evidenced by platform access data. In November 2022, the widely disseminated chatbot known as ChatGPT was launched. Two months after its launch, in January 2023, the tool had



already reached around 91 million weekly visitors. In 2025, ChatGPT reached approximately 800 million weekly visitors, representing a percentage increase of about 779% over two years (Exame, 2025; Valente, 2023). Also in 2025, 84% of Brazilian students stated they had used some type of AI tool in academic activities (Fundação Itaú, 2025).

However, the rapid growth in the use of chatbots was not necessarily accompanied by the development of critical practices in their usage. Utilizing these tools without due critical sense can generate unfavorable cognitive consequences for students.

Critical thinking can be defined, according to Gerlich (2025, p. 1), as “[...] the ability to analyze, evaluate, and synthesize information to make informed decisions [...]”. Thinking critically involves several cognitive processes that articulate with other complex skills, such as problem-solving and informed decision-making. For this to occur, the individual needs to be able to analyze different pieces of information and evaluate them discerningly (Gerlich, 2025).

The excessive use of AI may be associated with the increase of a process termed cognitive offloading, which occurs when individuals transfer certain mental tasks to external resources. A simple example of this process is recording a birthday date in a calendar: in this case, the information is no longer kept exclusively in memory and begins to be accessed externally, reducing the mental effort required to recall it.

When the use of AI tools becomes excessive, significantly reducing the cognitive effort dedicated to certain tasks, this process can evolve into what some authors term cognitive outsourcing. In this scenario, the individual ceases to analyze information autonomously and delegates part of the decision-making to the tool, which can reduce processes of reflection, engagement, and information retention over time, negatively affecting individuals in the learning process (Gerlich, 2025).

Another relevant point relates to academic production in higher education, which is frequently based on the elaboration of scientific texts. Academic writing



involves processes of research, critical analysis, and argumentative formulation. The excessive use of AI in textual production can compromise these processes, reducing investigative depth, amplifying reliance on unverified information, and potentially increasing the risks of plagiarism, since generative systems do not always present the origin of the information utilized (Zhai; Wibowo; Li, 2024).

Furthermore, a recurring scenario is observed across different educational institutions: the circulation of incorrect or inaccurate information produced by AI systems presented in well-structured texts, which can generate a false impression of reliability. The higher the level of trust in AI tools, the lower the independent verification of the generated information tends to be. This phenomenon is associated with so-called AI hallucinations, when generative systems produce plausible yet incorrect or non-existent information (Santos; Pereira; Matos, 2025; Trindade; Oliveira, 2024; Zhai; Wibowo; Li, 2024).

Another observed aspect refers to potential informational superficiality in some texts generated or mediated by AI. This characteristic can be observed in Figure 4, which presents the comparison between paper T1—produced in 2023, with greater descriptive development and stylistic variations, the presence of irregularities, and oscillation in textual fluidity, compatible with the conception of language as a heterogeneous social practice in which the text reflects situated and non-standardized construction processes (Marcuschi, 2008)—and paper T3, which presents textual organization predominantly in bullet points, with less detailed justifications associated with the decisions presented in the text.

Although recent, these studies already indicate important trends; a predisposition toward excessive synthesis, associated with the possibility of informational inaccuracies, raises concerns about the quality of recent academic productions, given that it can affect the development of analytical and investigative skills essential to university education.



In addition, some indicators of intensive use of AI tools include textual standardization, such as uniformity in the number of lines and sentences across paragraphs, repetition of similar discursive structures, and less conceptual depth. Such characteristics can be observed in Figure 3, which exemplifies patterns of homogeneous textual structure throughout the analyzed work.

The homogeneity observed in these texts, marked by the repetition of structures and lexical uniformity, can be interpreted, in light of Discourse Analysis, as a reduction in enunciative heterogeneity, a characteristic expected in situated productions (Orlandi, 2009). Such excessive regularity suggests a weakening of individual markers of authorship, bringing the text closer to a more stabilized and impersonal discursive pattern. Therefore, it becomes increasingly important to understand how students utilize these tools and to identify patterns that can guide pedagogical practices more suited to the contemporary technological context.

However, it does not seem plausible or productive to propose banning the use of AI tools by students. Such technologies are already widely present in different sectors of society, including companies, educational institutions, government organizations, and digital services. Completely preventing their use could limit learning opportunities related to the development of digital skills.

It is worth noting that, currently, there are no fully reliable methods capable of determining with precision whether a text was produced or not with the help of generative AI tools. As these systems are used by millions of users, they become increasingly capable of reproducing human language patterns. Thus, this study does not seek to categorically assert the use of AI in the analyzed texts, but rather to discuss linguistic and structural indicators that can contribute to reflections on recent changes in academic writing. The identification of these indicators is not restricted to counting occurrences, but involves an interpretative process in which the observed patterns are analyzed together, according to the assumptions of content analysis (Bardin, 2006).



Given this scenario, a central pedagogical challenge emerges: understanding how students can utilize AI tools in a critical, ethical, and reflective manner, so that these technologies effectively contribute to the learning process.

First of all, for students to develop information literacy, it is necessary for them to understand the risks and limits associated with the use of chatbots. The use of AI should be encouraged as a complementary and auxiliary resource, and not as a substitute for the academic work performed by the student. Only through the recognition of the limitations of these tools does a conscious and responsible use become possible (Lima; Serrano, 2024).

The development of information literacy involves building a specific set of skills. Among them, the capacity to identify the need to seek additional information on a given topic and to determine the required level of informational depth stands out. By recognizing these two fundamental aspects, the student begins to understand more clearly both what to search for and how to conduct the informational search process (Trindade; Oliveira, 2024).

In this context, the development of appropriate search strategies becomes essential, which includes the elaboration of efficient prompts. Prompts consist of clear and contextualized commands directed at AI tools. Although a command can be formulated through a simple sentence, more qualified responses tend to emerge when the command presents a higher level of contextualization, clarity, and detail (Brasil, 2025; Trindade; Oliveira, 2024).

Thus, users need to be guided to elaborate adequate prompts and encouraged to refine them progressively, adjusting the command until reaching more precise answers. This process not only improves the quality of the responses obtained but also contributes to the development of critical judgment regarding the information generated by the tool. Parallely, it is fundamental to stimulate the construction of search strategies that go beyond the exclusive use of AI tools (Trindade; Oliveira, 2024).



Chatbots can provide an initial and simplified contact with certain content; however, because they are not specialized tools, they frequently do not offer the conceptual depth necessary for the effective construction of academic knowledge. In this sense, the use of AI must be articulated with access to other informational sources, such as books, scientific articles, documentaries, and different types of specialized materials. This diversity of sources allows the student to triangulate information and subsequently make critical judgments regarding its reliability and relevance.

Another central aspect refers to the evaluation of the obtained information. It is necessary to recognize that AI systems can produce hallucinations and generate non-existent data. Awareness of this limitation favors a more critical posture toward the answers provided by chatbots, encouraging the search for multiple sources and contributing to the development of critical thinking during informational evaluation processes (Trindade; Oliveira, 2024).

The obtained information must be used creatively and incorporated into the students' knowledge base, a process that depends on real cognitive involvement and interaction with complex problems (Trindade; Oliveira, 2024). In this sense, it is recommended that instructors propose activities that go beyond simple tasks, such as directly answering a question, structuring learning situations that can be partially explored with the support of AI, but that also involve practical and reflective activities in the real world.

Another relevant point concerns the origin of the information generated by chatbots. Most of the time, the tools do not indicate the sources or authors of the presented information. Thus, when students use AI-generated content in academic texts without attributing due credit, they commit plagiarism. Respect for intellectual property constitutes, therefore, an essential dimension of information literacy. Although some tools can indicate references when requested, it is up to the user to verify the sources and perform the proper authorial attribution (Trindade; Oliveira, 2024).



With instructor guidance and continuous, critical, and informed use, it becomes possible to develop information literacy skills and productive interaction with AI tools. Banning the use of these technologies does not contribute to the development of these competencies; on the contrary, it can limit learning opportunities. Stimulating conscious and reflective use represents a more promising path for training students capable of assuming greater responsibility for the construction of their own knowledge.

Concluding Thoughts

This article sought to analyze whether the use of Artificial Intelligence tools has expanded among higher education students, based on evidence from academic papers produced at two distinct times. While the texts drafted in 2023 presented characteristics predominantly associated with spontaneous human writing, the 2025 papers exhibited an expressive set of moderate and strong indicators of AI mediation, including greater structural standardization, lexical neutrality, high syntactic fluidity, and low narrative variability.

However, it is important to highlight some limitations of this research. The analyzed corpus is small, composed of only four academic papers, which restricts the possibility of generalizing the results.

These transformations point to relevant pedagogical trends. Excessive dependence on AI tools in academic productions can favor phenomena such as cognitive outsourcing, a reduction in reflective capacity, and greater exposure to simplified or potentially incorrect information.

In this context, it becomes necessary to strengthen informational and digital literacy practices at different levels of education, encompassing both students and teachers. Such practices can be developed through courses, lectures, and practical pedagogical activities that encourage the critical and reflective use of these technologies in the educational environment.

Stimulating the assisted use of AI in activities that go beyond simple answers—involving creativity, analysis, and the construction of more complex



knowledge—can contribute to the development of informational competencies by both students and teachers.

Finally, future studies can expand the analyzed corpus, incorporating a larger number of textual productions and different areas of knowledge, in addition to investigating other levels of education. Subsequent research can also combine qualitative and quantitative approaches, allowing for a deeper understanding of the transformations in academic writing in the face of the growing presence of generative AI tools.

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Note

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