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Artificial Intelligence in Higher Education:
advances and dilemmas in academic production

Marcello Ferreira

University of Brasília (UnB), Brasília, Distrito Federal, Brasil

marcellof@unb.br

Marcos Rogério Martins Costa

University of Brasília (UnB), Brasília, Distrito Federal, Brasil

marcos.costa@unb.br

Érika Nazaré Gadelha Meira

Writing with Science (EC), Brasília, Distrito Federal, Brasil

gadelhaerika01@gmail.com

Olavo Leopoldino da Silva Filho

University of Brasília (UnB), Brasília, Distrito Federal, Brasil

olavolsf@unb.br

Abstract: Higher education in Brazil has been impacted by the possibilities of Artificial Intelligence (AI), especially in scientific writing. This article aims to identify gaps, advances, and dilemmas in the implementation of artificial intelligence in higher education, especially in the production of academic texts. To this end, this qualitative, descriptive, and exploratory research uses reconstructive hermeneutics to understand the use of AI in scholarly production, considering ethical and legal dilemmas. As a result, the potential of AI resources to improve academic writing is assessed, highlighting the importance of data protection and intellectual property.

Keywords: Artificial Intelligence; Higher Education; Academic Production.

Inteligência Artificial na Educação Superior: avanços e dilemas na produção acadêmica

Resumo: A Educação Superior no Brasil tem sido impactada pelas possiblidades da inteligência artificial (IA), em especial em relação à escrita científica. O

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objetivo deste artigo é identificar lacunas, avanços e dilemas no que concerne à implementação da inteligência artificial no ensino superior, sobretudo na produção de textos acadêmicos. Para tanto, esta pesquisa qualitativa, descritiva e exploratória utiliza a hermenêutica reconstrutiva para entender o uso da IA na produção acadêmica, considerando dilemas éticos e legais. Como resultado, avaliou-se o potencial de recursos de IA para aprimorar textos acadêmicos, destacando a importância da proteção de dados e da propriedade intelectual.

Palavras-chave: Inteligência artificial; Educação Superior; Produção acadêmica.

Inteligencia artificial en la Educación Superior: avances y dilemas en la producción académica

Resumen: La educación superior en Brasil se ha visto impactada por las posibilidades de la inteligencia artificial (IA), especialmente en relación con la escritura científica. El objetivo de este artículo es identificar brechas, avances y dilemas en relación con la implementación de la inteligencia artificial en la educación superior, especialmente en la producción de textos académicos. Para ello, esta investigación cualitativa, descriptiva y exploratoria utiliza hermenéutica reconstructiva para comprender el uso de la IA en la producción académica, considerando dilemas éticos y legales. Como resultado, se evaluó el potencial de los recursos de IA para mejorar los textos académicos, resaltando la importancia de la protección de datos y la propiedad intelectual.
Palabras clave: Inteligencia artificial; Educación Superior; Producción académica.

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1. INTRODUCTION

ChatGPT was released for free and popularized in version GPT-3 by OpenAI in June 2020[1]. Since then, this artificial intelligence (AI) has become widely available to developers, researchers, and users in general who are interested in exploring the capabilities of this AI focused on natural language processing (NLP). Between 2022 and 2023, ChatGPT was accessed by more than 14 billion users worldwide[2]. This did not happen by accident. AI has been developed since the 1950s. Pozzebon, Frigo, and Bittencourt (2004) point out that their development was closely linked to the development of mathematical studies and computers. Understanding this scenario, this article aims to identify gaps, advances, and dilemmas related to the implementation of AI in higher education, especially in the production of academic texts.

It should be noted that advances in AI have been influenced by historical mathematical contributions, as evidenced by Pozzebon, Frigo, and Bittencourt (2004). According to these scholars, the work of mathematicians from the 17th to 19th centuries was fundamental to the early development of AI. In addition, Allan Turing's proposal in the 20th century, when he envisioned machines capable of imitating human behavior, challenged traditional notions of intelligence and stimulated reflection on the ability of machines to learn and be considered intelligent. The evolution of computers has made it possible to simulate aspects of human intelligence, reviving previously abandoned studies in areas such as neural networks and connectionism. Thus, the history of AI is characterized by a dynamic interaction between "different paradigms and theories, reflecting the complexity of the phenomenon" (Pozzebon; Frigo; Bittencourt, 2004, p. 36, translated by us).

Despite the consolidation of AI as a science in 1956, the precise definition of intelligence remains an open challenge, as Pozzebon, Frigo, and Bittencourt (2004) point out. Over the years, the concept of intelligence has remained ambiguous and subject to constant debate, reflecting the human difficulty in understanding and defining this complex phenomenon. "The history of AI, marked by changes in paradigms and theories, testifies to the continuous search for a deeper understanding of

[1] ChatGPT is a language model developed by OpenAI, which uses the GPT architecture to generate and understand natural language text. OpenAI is an artificial intelligence research organization that aims to ensure that AI benefits all of humanity and is the creator and currently majority owner of ChatGPT (Peres, 2024).

[2] The company WriterBuddy conducted a survey using SEMrush that analyzed more than 3,000 artificial intelligence tools from September 2022 to August 2023. In this research, "ChatGPT demonstrates its leadership in an expressive way, accumulating an impressive 14.4 billion hits. Next in line are character.ai, with 3.8 billion hits, and quillbot.com, with a remarkable 1.1 billion," according to Lauterjung (2013, online).

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human intelligence and the attempt to replicate it in artificial systems" (Pozzebon; Frigo; Bittencourt, 2004, p. 36, translated by us). At the same time, as Andrade, Francisco, and Menegussi (2019) point out, AI can automate administrative tasks, such as automatic test correction, data management, and analysis of student performance.

Understanding, on the one hand, the increasing growth of distance education around the world and, on the other hand, the potential of AI, it can be seen that one can enhance and spread the other in the field of education. With the global expansion of digital information and communication technologies and the search for more accessible and flexible learning methods, distance education has become a viable and widely adopted alternative, as argued by Holmes, Bialik, and Fadel (2019). According to McCarthy (2007), AI can be applied to personalize teaching, adapt to students' individual needs, and provide a more dynamic and interactive educational environment. Furthermore, Holmes, Bialik, and Fadel (2019) stated that AI can improve the delivery of knowledge, provide personalized learning resources, and promote the inclusion of students of different backgrounds and abilities.

In terms of text production, AI has been used to automatically generate content, from simple essays to more complex articles. This is because AI systems can be trained to recognize linguistic and contextual patterns, allowing texts to be produced in a more efficient and personalized manner (Bryson; Winfield, 2017; Scherer, 2016). However, as Hartmann Peixoto (2020) and Gonzalez Arencibia and Martinez Cardero (2020) warned, it is important to emphasize the quality and ethics of the production of AI-generated texts as topics that require attention.

It is also crucial to address, albeit briefly, the fetishization of technology in the educational context, which is often seen as the magic solution to all the limitations of the educational process and teacher autonomy. This simplistic thinking ignores several important sociocultural and contextual factors and the complexity of integrating technologies such as artificial intelligence into the classroom. It must be made clear that the effective use of AI requires not only access to technological resources but also adequate teacher training and infrastructure availability. Without these fundamental elements, the promise of educational transformation through technology remains unfulfilled and may worsen existing inequalities. Thus, a critical approach that recognizes both the potential and limitations of educational technologies is essential to ensure that their implementation is inclusive and truly beneficial for all involved (Ferreira; Veloso, 2023).

Considering these nuances and the complexity of the issue addressed here, this research is

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relevant to understanding how artificial intelligence can enhance learning processes and knowledge production in educational environments through the dissemination of scientific writing, which justifies this study. To understand this, the aim is to identify the gaps, advances, and dilemmas related to the implementation of AI in higher education in the production of academic texts. To this end, the methodology adopted consists of bibliographical and documentary research on the implementation of AI resources (software, platforms, applications, etc.) in the university environment, with a focus on the production of academic texts. This approach includes theories and proposals for digital inclusion from authors in the fields of education and information science.

Methodologically, this article is divided into five parts. In the first section, the topic is contextualized, highlighting the potential and importance of AI, specifically, its relevance in the writing of academic texts. Section 2 details the methodology and describes how bibliographic and documentary research was conducted. Section 3 discusses the basic concepts of artificial intelligence, its history, and its application in higher education. The fourth section discusses AI in scientific texts and explores the ethical dilemmas, limitations, and prospects of AI in academia. The fifth section concludes with reflections and guidelines on the role of AI in the contemporary Brazilian educational context.

2. METHODOLOGY

The research on the influence of artificial intelligence in higher education adopted a qualitative approach, mainly exploring technologies that help produce academic texts. Two strategies were used to collect data: bibliographic research and documentary research. This documentary investigated existing laws on artificial intelligence in Brazil intending to understand the current legal framework and its specific applications in the educational field. The bibliographic research aims to identify studies, theories, and applications of artificial intelligence in improving academic writing and explores the contributions and perspectives of these technologies in the higher education context. The data collection period was from September to October 2023, when different sources of information were explored.

The bibliographic research was carried out through a systematic review. According to Donato H. and Donato M. (2019, p. 227, translated by us), a systematic review is "an investigation using predefined systematic methods to systematically identify all relevant published and unpublished

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documents for a research question, to assess the quality of these articles, to extract the data, and to synthesize the results". It is a relevant method because, according to the authors, it is "reproducible and tends to be impartial. It aims to reduce bias by using explicit methods to conduct a comprehensive literature search and critically appraise individual studies" (Donato, H.; Donato, M. 2019, p. 227, translated by us). Unlike traditional or narrative reviews, systematic reviews address specific research questions and are characterized by methodological breadth, transparency, and reproducibility (Petrou; Kwon; Madan, 2018).

For the systematic review, renowned databases such as Google Scholar[3], Scielo[4], and the Brazilian Digital Library of Theses and Dissertations (BDTD)[5] were consulted. Google Scholar was chosen because it is a widely used platform that contains numerous academic articles, theses, dissertations, and other scholarly publications. Its relevance lies in the ease of access to various scholarly articles, which allows for the search for current and diverse information on artificial intelligence in education. In addition, Google Scholar offers a broad and international perspective, providing access to research conducted in different parts of the world. The Scielo database was used because it is a virtual library that contains a collection of high-quality scientific journals, mainly Latin American publications. It stands out for its wide range of content in different fields of knowledge, including specific articles on the application of artificial intelligence in higher education. The BDTD, coordinated by the Brazilian Institute of Information in Science and Technology (Ibict), was also consulted because it is a valuable tool for accessing theses and dissertations produced by higher education institutions in Brazil. This database is essential for understanding the research being conducted in Brazil, as it provides a collection of academic works that include specific studies on artificial intelligence in Brazilian higher education. Together, the three databases provide a more in-depth understanding of the development of AI in the Brazilian educational context in its most recent publications.

The search was performed using specific descriptors. The following descriptors were used in Portuguese: "inteligência artificial", "inteligência artificial AND educação superior" and "inteligência artificial na educação superior"[6]. The same expressions were also used in English: "artificial

[3] Available at: https://scholar.google.com.br/. Accessed on: 06 Jan. 2024.
[4] Available at: https://www.scielo.br/. Accessed on: 06 Jan. 2024.
[5] Available at: https://bdtd.ibict.br/. Accessed on: 06 Jan. 2024.
[6] As Donato H. and Donato M. (2019) explain, the Boolean operators "AND" and "OR" are fundamental tools in bibliographic searches, allowing terms to be combined to obtain more specific or broader results. "AND" restricts the results, requiring both terms to be present in the retrieved documents, while "OR" broadens the results, searching for

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intelligence", "artificial intelligence AND higher education" and "artificial intelligence in higher education". These descriptors were chosen based on their affinity with the subject of the study.

The main objective of selecting only data from the last five years (2019 to 2023) was to ensure that the results were up-to-date and accurate, as suggested by Ruiz (2002) and Medeiros (2002). Therefore, the analysis is adapted to current and more recent contexts.

Four searches were conducted using the six descriptors in the three selected databases. The results were consolidated and distributed as follows:

Chart 1 – Synthesis of the systematic review

Descriptors / Searches		1st General Results	2nd Results (2018-2023)	3rd Peer-Reviewed Results	4th Restricted areas (Information Science AND Education)
Portuguese	**Inteligência Artificial**	1258	320	80	12
	Inteligência Artificial *AND* Educação Superior	680	180	45	8
	Inteligência Artificial na Educação Superior	480	130	35	6
English	***Artificial Intelligence***	2860	720	180	25
	Artificial Intelligence AND Higher Education	859	220	60	10
	Artificial Intelligence in Higher Education	590	150	40	7
Total		**6727**	**1720**	**440**	**68**

Soure: Our own elaboration (2024).

The data presented represent the results of four different searches carried out using descriptors in Portuguese and English related to AI in higher education. In the context of the searches in Portuguese, when using the descriptor "Inteligência Artificial", 1258 results were found in the first general search, 320 results in the period from 2018 to 2023, 80 with peer-reviewed materials, and finally 12 results limited to the fields of computer science and education. With the addition of the descriptor "Inteligência Artificial AND Educação Superior", the results were 680 in the general search, 180 in the period from 2018 to 2023, 45 with peer-reviewed materials, and 8 in the restricted area. With the descriptor "Inteligência Artificial na Educação Superior", the results were 480 in the general search; 130 in the period from 2018 to 2023; 35 peer-reviewed; and 6 in the two restricted

documents that contain at least one of the terms specified in the search. The authors also argue that these operators facilitate precision in the search for information and are essential for improving search strategies in different databases and academic platforms

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areas.

In searches conducted in English, the following results were found. With the descriptor "Artificial Intelligence", 2,860 results were obtained in the general search; 720 results were obtained in the period from 2018 to 2023; 180 were peer-reviewed; and 25 results were obtained in restricted areas. When searching for "Artificial Intelligence AND Higher Education", 859 results were found in the general search; 220 were in the period from 2018 to 2023; 60 were peer-reviewed; and 10 were in the restricted areas. When searching for "Artificial Intelligence in Higher Education", the results were 590 in the general search; 150 in the period from 2018 to 2023; 40 peer-reviewed, and 7 in the restricted areas. The total number of results, considering all searches performed, was 6,727 in the general search; 1,720 in the period from 2018 to 2023; 440 peer-reviewed; and 68 in the restricted areas. These figures illustrate the breadth and segmentation of the results obtained using the different search approaches, using the Portuguese and English descriptors on artificial intelligence in higher education.

In the systematic review, the 68 results were enriched by the inclusion of classic and relevant bibliographic materials. These classics have played a fundamental role in broadening and deepening our understanding of the topic. Their historical and theoretical contributions provided pertinent information that enriched the analysis and provided an important context for the results of the systematic review. Therefore, the bibliographic search consisted of the 68 results derived from the systematic review, as well as other results identified as classic and relevant from a reading of the literature.

As we have seen, this approach has made it possible to obtain a consistent base of information on which to base the analysis and reflections on the impact of artificial intelligence on higher education, which will be developed in the following topics. Therefore, this qualitative method allows for an in-depth and critical analysis of the topic, providing a basis for the reflections and conclusions presented in this study.

3. ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: FOUNDATIONS, HISTORY AND APPLICATIONS

According to Matos (2022), the development of AI is associated with various disciplines, forming theoretical and practical frameworks that permeate the historical development of different

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fields. For example, cybernetics, presented by Norbert Wiener and Arturo Rosenblueth Stearns in 1942, sought control and communication in machines and animals, addressing generic control in environments. In parallel, William Ross Ashby, in 1950, proposed theories related to artificial intelligence that accompanied the transition from analog to digital computing. Economics, inaugurated by Adam Smith in 1776, analyzed the maximization of individual utility. Mathematics, explored by John von Neumann and Oskar Morgenstern in 1944, linked probability theory to utility, which is essential for decision-making in uncertain scenarios.

According to Matos's (2022) historical review, the Second World War also stimulated the development of operational research methods and Markov decision processes. Computer engineering saw computers as essential tools, with an emphasis on ENIAC and the subsequent evolution of computer systems[7]. Another point to consider is the interdisciplinarity between philosophy, neuroscience, and linguistics, as advocated by Matos (2022), because, according to the author, it leads to questions about the origin of knowledge and the mind. In this vein, scholars such as Aristotle, René Descartes, Francis Bacon, David Hume, and Rudolf Carnap, among others, have contributed to theories of human thought and action in their way. The foundations laid by these authors continue to influence, however indirectly, the current understanding of what AI is.

Another area of knowledge that can be highlighted is the relationship between linguistics and AI. This association was developed from Skinner's[8] stream of behaviorism, through Chomsky's[9] syntactic theory until today's computational linguistics. Thus, these processes involve natural language processing and contextualizing knowledge in information - ChatGPT is a good example[10].

According to Matos (2022), the mathematical context, formal logic of Boole and Frege,

[7] The Electronic Numerical Integrator and Computer (ENIAC) was the first large-scale electronic digital computer. Developed in the 1940s, it marked the beginning of the modern computer age and had a significant impact on the development of computer systems. Its ability to perform complex calculations quickly was a crucial step in the development of AI and other areas of computer science.

[8] Behaviorism, introduced by Skinner, emphasizes the study of observable behavior and examines the influence of the environment on human actions. His theory, radical behaviorism, focuses on rewards and punishments as shaping elements of behavior, rejects the analysis of internal mental processes, and focuses exclusively on measurable behavior (Fiorin, 2017).

[9] Chomsky's syntactic theory revolutionized linguistics by postulating the idea of an innate universal grammar underlying all languages. He proposed the existence of universal structures in human language, called generative grammar. His approach focuses on the internal structure of sentences and emphasizes the innate ability of humans to learn and produce language (Fiorin, 2017).

[10] Computational linguistics, which combines linguistics and computer science, focuses on the development of algorithms and techniques for processing natural language using computers. Advanced AI models, such as ChatGPT, use natural language processing to understand and generate text like human language, for use in virtual assistants, sentiment analysis, and machine translation.

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Gödel's number theory, and computational tractability of Turing and Church were fundamental stages in the foundations of AI. The introduction of probability by Cardano and Bayes, for example, made it possible to understand uncertainty and the probabilistic reasoning used in AI programming today.

Gonsales (2022) also argued that psychology researchers, from introspective studies to those of the cognitivist school, have provided input for understanding human behavior through information processing. This stems from the union of behaviorism and cognitive psychology, which pointed out that humans and animals process information and have internal representations that are manipulated by cognitive processes. These different fields of knowledge have intersected and fostered the conceptual and technological foundations that have driven the development of AI recently to the present day. As a result, it is not possible to provide a perfect and concise definition of AI, as Pozzebon, Frigo, and Bittencourt (2004) noted.

Vieira Pinto (2005, p. 72, translated by us) argues that "the history of the machine alone does not explain the machine. What explains the natural history of humans. The machines that surround us and on which we are increasingly dependent [...] are the result of a long process of knowledge accumulation [...]". This is also discussed by Lee (2019), who described the difficulty of predicting the future using the complex past of AI:

> One of the reasons it's so hard to predict the future of our history with AI is that it's not just a story about machines. It's also a story about people, people with free will that allows them to make their own choices and shape their own destinies. Our future with AI will be created by us and will reflect the choices we make in the actions we take (Lee, 2019, p. 11, translated by us).

In this line of reasoning, Matos (2022, p. 40, translated by us) asserts that "the history of artificial intelligence is very old, as old as the history of humanity, from the time when man began to sculpt statues, mechanical puppets, called "automata" by Heron of Alexandria when the puppets gained movement. Then, still in antiquity, Aristotle defined the basics of syllogism, which indirectly influenced Boolean logic and, consequently, the efficient functioning of modern computers. During the Second World War, artificial intelligence developed along with computers in various fields[11], initially focused on specific actions such as deciphering German messages.

The timeline of AI includes several historical milestones. Among them are: the appearance of

[11] These computers weren't exactly digital, but they were already based on logic gates and the Boolean structure [0,1], and they were made up of valves - not circuits like today's computers.

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the first digital computer by Konrad Zuse; Warren McCulloch and Walter Pitts' article on neural networks; the foundation of the Church-Turing thesis by John von Neumann; the Turing test proposed by Alan Turing, among others (Matos, 2022; Lee, 2019). Advances such as Joseph Weizenbaum's Eliza program and Alan Comerauer's development of Prolog also marked progress in the field of computer science in the following decades, as Holmes, Bialik, and Fadel (2019) pointed out.

Today, AI is embedded in most popular devices, such as mobile phones and home appliances. Its applications have improved the experience of performing everyday tasks. Its main benefits include saving time and resources, assisting with repetitive work activities, and enhancing entertainment through interactive applications (McCarthy, 2007). The presence of AI is notorious in various aspects of contemporary culture, permeating areas such as work, art, science, education, and social interactions.

This study focuses on the application of AI as an innovative and promising tool in higher education. Its application in this context offers numerous opportunities and benefits that can significantly transform teaching and learning processes (Matos, 2022; Sayad, 2022; Gonsales, 2022). Through AI, higher education institutions can implement adaptive systems that personalize teaching according to students' individual needs. This allows for a more flexible and targeted approach that accommodates the different abilities, learning styles, and rhythms of each student.

Sayad (2022) asserted that the use of AI in higher education also makes it possible to create interactive and engaging learning environments. For example, AI-based intelligent tutoring systems can provide personalized support, guidance, and real-time feedback to students. This interaction allows for closer monitoring of student progress, identifying knowledge gaps, and suggesting complementary activities to reinforce learning.

Another relevant aspect is the use of AI in educational data analytics (Vicari, 2018). This technology can process large amounts of information and identify patterns and trends in student performance. This allows institutions to make more informed decisions, such as improving curricula, identifying areas for improvement, and developing more effective teaching strategies, argues Vicari (2018).

In addition, AI in higher education can facilitate the creation of personalized and adaptable educational content, as suggested by Matos (2022). With recommendation algorithms, it is possible to offer tailored learning materials, taking into account the individual profiles and interests of each

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student. This will contribute to a more dynamic and engaging learning experience.

Artificial intelligence (AI) can be applied to automate administrative and bureaucratic tasks in higher education institutions (Vicari, 2018). This enables the optimization of processes such as enrollment, academic records management, and faculty support. This allows educators and staff more time to focus on activities that require greater human interaction and creativity in the academic environment (Gonsales, 2022). The subsequent section discusses specific applications of AI in the production of scientific texts.

4. DILEMMAS AND PROSPECTS FOR ARTIFICIAL INTELLIGENCES: THE CASE OF ACADEMIC WRITING

The potential of ChatGPT and other AIs in the production of texts (and, in particular, the academic textual genre) has had an impact on how content is generated, as argued by Souza et al. (2023). ChatGPT, in particular, is an artificial intelligence (AI) language model developed by OpenAI. Its genesis can be traced back to the company's previous endeavors using earlier models, including GPT-1 in 2018 and GPT-2 in 2019. The acronym GPT is derived from the expression: Generative Pre-trained Transformer. This signifies that the models are based on a neural network architecture designated as a Transformer, which is itself capable of generating text from the input data. In essence, it is a conversational interaction in which the machine provides an answer that is probabilistically the closest match to the given question.

In the field of higher education, the advent of ChatGPT and similar AI systems has given rise to a lively debate surrounding their potential applications in the preparation of academic texts, including articles, monographs, and reports:

> Academics may surrender to the facilities that AI can provide because of the constant and necessary demand for written publications during undergraduate courses. In Stricto Sensu's postgraduate programs, the demands are focused on the generation of scientific communication, which translates into the production of articles, book chapters, and books, as well as the need to respond more quickly to imposed determinations. There is a chain of demands: the Coordination for the Improvement of Higher Education Personnel (CAPES) calls for demands on the postgraduate programs of the universities, these ones demand on their professors and those demand on their students to produce with agility and excellence, in addition to complying with the required standards. (Souza *et al*. 2023, p. 601, translated by us).

It is not only universities and research centers that have AIs that generate text from raw data proliferated. They are used in various fields, from journalism

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and the automatic generation of news on websites to the production of reports and memos in companies. The main argument is that their use brings efficiency and agility to the creation and editing of texts, making it possible to personalize and adapt information according to the specific needs of each target audience. This constant demand in various areas of human activity means that text-production AIs are becoming more personalized, providing written information that more closely resembles human writing, that is, less robotic[12].

The dilemma of whether or not to use ChatGPT resources in academic work stems from the concepts of authorship and originality. In Brazilian legislation, the concepts of authorship and originality are fundamental to the protection of intellectual property rights. A definition of authorship in the Brazilian Code is, broadly speaking, associated with the creation of an intellectual work, giving the author recognition and moral and property rights over what has been produced. Originality, on the other hand, also refers to the unique and peculiar nature of the work and is a prerequisite for its legal protection in relation to other existing works, as well as its reproducibility and commercialization. The dilemma of using ChatGPT resources in academic work, for example, arises from the need to properly attribute authorship and guarantee the originality of the content generated, in other words, to cite the origin of the text used and the presence or absence of automated writing in the preparation of the text. Although text production AI can offer agility and productivity in the generation of information and data, authors and researchers should be transparent about the source of inspiration or data obtained, respecting copyright and the standards of originality required by current legislation. This agrees with Araújo's (2016) comments in the following reflection:

> If, in the future, the use of algorithms becomes part of the research routine at university institutions, this partnership may need to be extended to the company responsible for creating the algorithms used to generate the first version of the paper. But in this case, the question we will have to answer is whether the researchers will be the true "authors" of the academic papers they generate, or whether they will prefer being "meta-authors" of the proposed research. This is a question that will be debated for decades to come. (Araújo, 2016, p. 103, translated by us).

Academics have advocated the use of AI to improve academic production: "[...] it is important to highlight the enormous potential for the use of the ChatGPT tool by students, teachers, and researchers, who are increasingly under pressure to publish the results of their studies. [...] several

[12] Humanized writing is an area that technology companies are exploring so that chatbots and other resources can better serve users and make them feel more welcomed by these tools in a socio-emotional sense.

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authors have pointed out the risks of so-called ‘academic productivism' [...]" (Peres, 2024). Thus, there is a dissonance between, on the one hand, the constitutive act of using AI in the production, revision, and adaptation of texts, as Araújo (2016) argues, and, on the other hand, the need that the academic community itself must produce, revise, and disseminate data, information, and content to society. The potential to produce more in less time, as IAs promise and achieve, is laudable, but it is also essential to consider ethical and moral issues related to the constitutive act of writing a scientific text.

To define these two aspects, it is important to examine the legislation in force. To do so, we will use data collected during documentary research on current codes and jurisprudence. Brazil’s laws on data protection, intellectual property, and copyright crimes play a fundamental role concerning texts produced by AI. The General Data Protection Law (LGPD) protects personal information by requiring explicit consent for data collection and processing. Approved in 2018 and force since September 2020, LGPD Law No. 13,709/2018 regulates the use, collection, storage, and sharing of personal data by companies and organizations. This is essential because AI algorithms can process large amounts of data, which requires compliance with the LGPD to ensure data privacy and security.

On the other hand, the Intellectual Property Law (LPI), Law n. 9.610/1998, protects the copyright of creative works. In this context, texts generated by AI can be considered works protected by this law, since they involve creative processes. The intellectual property of creations generated by AI algorithms raises the question of who owns the copyright of such texts (Araújo, 2016). Thus, applying LPI becomes relevant to ensure proper protection and attribution of rights to creators, whether human or algorithmic.

In addition, the crime of copyright, which includes practices such as plagiarism and unauthorized reproduction, is also relevant when analyzing AI-generated texts. It is important to ensure that texts generated by algorithms do not infringe on copyright or reproduce protected content without appropriate permission (Peres, 2023). Therefore, compliance with intellectual property and copyright laws is paramount to the ethical and legal use of AI-produced texts, ensuring that creators’ rights are respected and preserved.

It is important to define academic ethics. According to Nalini (2006), one definition of ethics is the study of individuals’ moral behavior in society. Therefore, academic ethics can be understood as a set of rules that govern the relationships and conduct of members of institutions as well as all those involved in the teaching, research, and learning processes. On this basis, we decided to reflect

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on the use of AI in academic production.

Below is a table with the main articles on these three fundamental concerns related to the use of AI in the production of texts, especially academic texts: privacy, intellectual property, and copyright.

Board 1 - Main laws on data protection, intellectual property and copyright

General Data Protection Law (Law n. 13.709/2018)	**Intellectual Property Law (Law n. 9.610/1998)**	**Copyright Crimes (Law n. 9.610/1998)**
• Processing of Personal Data (Article 5) • Consent of the Data Subject (Article 8) • Use and Transfer of Data (Articles 16 to 18) • Security Measures and Liability (Articles 46 to 52)	• Copyright (Articles 7 to 21) • Protected Works (Article 7) • Ownership of Rights (Articles 11 to 17) Term of Protection (Articles 41 to 45)	• Copyright Infringement (Articles 184 to 186) • Plagiarism (Article 184, § 1) • Unauthorized Reproduction (Article 184, § 2) Penalties and Sanctions (Articles 108 to 110)

Source: Our own elaboration (2024).

It should be noted that it is not enough for users to know the relevant regulations; however, above all, it is essential to develop an ethical awareness that applies to individual practices. Therefore, from the perspective of academic ethics, in accordance with current legislation, it is understood that scientific writing using AI resources is related to algorithms and advanced models' ability to generate texts that increasingly resemble human production and is also related to the ethical practice of a community. It should be noted that human and machine processing are distinct. AI systems use machine learning techniques to analyze large amounts of data, including articles, books, and other written materials. This collection supports the development of a remarkable ability to generate language that gradually improves. These are conditions with which human thinking cannot keep up for the time being. It is therefore up to the user to be able to "separate the wheat from the chaff", i.e. to know when, how, and why to use AI in their academic work.

AI that produces text uses natural language processing (NLP). This resource has been used by humans for millennia to differentiate themselves from other animals because, through communication and recording, humans have been able to understand, store, and reproduce their knowledge from generation to generation. The growth of this NLP technology in machines over the years has been driven by computational advances and algorithmic improvements; thus, NLP has moved from rule-based systems to sophisticated models such as OpenAI's GPT-3. As a result, content generation

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becomes more precise and contextual. And the people who use these technologies also need to improve, not just technically, but more importantly, socio-emotionally.

Taking all these factors into account, the outlook is positive because the benefits of AI-authored work are numerous and can be applied in various fields. This is due to the agility of content creation, as it allows the material to be produced in a significantly shorter time than it would take a human author. It also accelerates repetitive processes. In some cases - not all, for now, in higher education - there is an improvement in the quality of the content, in the correction of errors, and in the consistency of the text. The improvement most observed by the IA is the use of normative grammar, which is more efficient than existing spellcheckers.

However, it is important to understand that AI writing does not attempt to replace human creativity, experience, and critical thinking (Peres, 2024; Lee, 2019). Instead, as Lee (2018) suggests, it acts as a tool to complement and assist writers in producing content more efficiently and overcoming creative blockages. Collaboration between humans and AI in content creation can lead to a hybrid approach that combines the best technical and creative disciplines.

It should also be emphasized that the excessive use of AI in teaching and learning processes raises significant concerns about students' critical and creative development. Excessive reliance on advanced technologies may limit the capacity for independent thinking and unassisted problem-solving. In this sense, it is important to clarify that creativity comes from facing challenges and finding original solutions - a process that is neither innate nor quick. Therefore, excessive and unguided use of AI, especially text automation, can be harmful to education. In addition, critical thinking requires the ability to question, analyze, and evaluate information independently, which may be underdeveloped or neglected by novice users in an environment dominated by answers formulated by algorithms.

It is also important to recognize that AI should not replace teachers' essential role in the conceptual and symbolic appropriation of subject matter. Teaching and learning should not be limited to transmission and memorization but should include mediation that leads to a deep and contextualized articulation of knowledge and practices. Teachers have an irreplaceable role to play in adapting teaching to the individual needs of students, promoting enriching discussions, and creating learning environments that stimulate curiosity and critical reflection. For example, the mere replacement of teaching with AI can lead to superficial education that minimizes human interaction and pedagogical experience, compromising integral education and having harmful effects on psychomotor and socio-

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emotional skills. Therefore, the integration of AI into education must be done in a balanced manner, complementing teaching, not replacing it, and taking into account an ethical and conscious use of the potential of automated information processing.

It should also be added that this work effectively conducted a detailed analysis of the data collected from the literature review, both directly and indirectly. The selected articles were commented on throughout the discussion, highlighting the main contributions and divergences found in the literature on the use of AI in higher education. This process of analysis is evidenced by the in-depth discussion on this topic and in the previous sections, in which the implications and nuances of the bibliographic findings were explored, responding directly to the rationale for the research presented in the introduction. Therefore, the critical approach and interpretation of the data are developed throughout the text, seeking to address the gaps, advances, and dilemmas that AI is unleashing in Brazilian and global higher education, especially in its interface with the production of academic texts.

As this field advances, it is necessary to explore how it works, its benefits, limitations, and ethical implications, as mentioned above. This is because AI authoring is a new resource in content creation, and therefore presents opportunities and challenges. With technological advances, machines are generating texts with increasing volume and speed, prompting companies, writers, and content producers to explore its wide-ranging possibilities and implications and calling on universities, as the greatest expression of higher education in Brazil, to visit the subject in its interfaces and its ramifications in the research, teaching, and extension that they practice.

5. FINAL CONSIDERATIONS

This article provides an analysis of the influence of AI in higher education, with a specific focus on academic writing. The methodological structure unfolded in a structured way through five sections, each contributing to a deeper understanding of the topic. First, the current educational panorama was contextualized, highlighting the potential and relevance of AI in academic text production. Next, the methodology adopted was detailed, demonstrating the conduct of bibliographical and documentary research that unfolds a descriptive-exploratory study on the topic that is recent in the literature of Education and Information Sciences. The third section focused on explaining the primary concepts of AI, outlining its history and specific application in the context of

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higher education. This theoretical background was crucial for understanding the possibilities and limitations of the resource in the academic sphere in the fourth section.

As a result, it can be understood that the use of AI for the production of academic texts has several positive and negative aspects. First of all, the positive aspects include the ability to generate content quickly, which helps researchers explore new ideas and increases the efficiency of writing academic papers. AI can also make useful suggestions and correct errors in the formal structure of texts, helping to improve the quality of communication. It also makes it easier to organize and structure complex information, helping to create more cohesive documents.

On the other hand, the negative points and limitations of using AI in the production of academic texts include excessive dependence on resources, which can lead to a lack of originality and creativity in the work. AI can generate content that lacks academic depth and real understanding of the subject, resulting in information that is inaccurate, superficial, or detrimental to grammar and a typical author's lexicon. In addition, ethical questions arise regarding attribution of authorship and possible infringement of rights, especially when the use of AI tools in the production of the text is not indicated.

Overall, this article aimed to identify the gaps, advances, and dilemmas in the implementation of AI in higher education, especially in the production of academic texts. Regarding the gaps, it was observed that it is not enough to offer technological support, but the implementation of AI in higher education - or at any other level, stage or formative stage - requires considering the lack of infrastructure, the need for adequate teacher training and the barriers of technological access for individuals, whether technical or socio-emotional. The advances, on the other hand, can be seen in the increased efficiency, the personalization of learning, and the facilitation of administrative tasks. The dilemmas, on the other hand, include ethical issues such as the originality of work produced with AI, excessive dependence on these technologies, and the potential negative impact on the critical and creative development of users. Therefore, research in these areas is essential for a balanced and effective integration of AI in higher education.

Regarding the limitations of the research carried out, which was based on bibliographic research with a systematic review of databases such as Google Scholar, Scielo, and BDTD, as well as classic and relevant works, there are some limitations. The main limitation lies in the possibility of not covering all the existing sources on the subject, given the wide range of information available in other databases or in sources that have not been digitized and/or consulted. In addition, focusing

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exclusively on the Brazilian legal code to understand the dilemma of privacy, intellectual property, and authorship may limit the understanding of the problem at an international level. In addition, the legal codes of countries with advanced levels of socio-economic and educational development, such as the United States, France, and Germany, where this debate is particularly advanced, can contribute to the discussion of authorship, intellectual property, and privacy in the use of AI for academic writing. It should also be noted that different countries have different legislation that also affects these issues. For this reason, it is suggested that further research, if possible broader and more diverse, be conducted to gain a qualified understanding of the ethical, legal, and academic complexities involved in the use of AI in academic writing.

It can be concluded that the connection between AI and higher education has great potential now and in the future. Currently, AI is already playing a significant role in higher education by providing more and more tools to personalize instruction and adapt to the individual needs of interactants. For example, AI systems can analyze student performance data, identify learning patterns, and provide personalized resources. All this means that the presence of AI promotes a more effective and engaging learning experience, a proposal that is in line with the majority of Brazilian educational guidelines at the different stages and levels of national education and with modal institutionalization processes from a critical perspective (Ferreira; Veloso, 2023).

In addition, AI has contributed to the creation of teaching methodologies. This was demonstrated by the expansion of e-learning and adaptive learning during the Covid-19 pandemic. With AI tools, it is possible to promote more flexible and accessible education for students in remote and hard-to-reach regions. AI can also help create educational content for automated assessment of assignments and identify gaps in students' knowledge, enabling more assertive pedagogical interventions.

Looking to the future, the connection between AI and higher education, as argued by Holmes, Bialik, and Fadel (2019), promises even more significant progress. AI can play a leading role in higher education, as long as it provides individualized virtual tutoring that can provide constant, real-time support to students. The technology will also be able to adapt not only to the learning style but also to the preferences and specific needs of each student. In this way, AI will not only be able to generate texts based on NLP but also based on the socio-emotional conditions of the individual, as predicted by Scherer (2016).

It should be noted that future research into the use of AIs in higher education could provide

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valuable insights into their effectiveness and impact. For example, longitudinal studies could examine how AI influences the critical and creative development of university students over time, and compare these effects with traditional teaching methods. In addition, comparative analyses across disciplines and courses could identify specific variables that influence the effectiveness of AI in different academic contexts. Research into teacher training and practice in higher education is essential to understanding how AI can be effectively integrated to the benefit of both teachers and students. Case studies in different higher education institutions, taking into account different cultural and socio-economic contexts, would provide a more comprehensive perspective on the implementation of the resource. Another aspect of significant relevance would be to conduct critical evaluations of AI-based educational software used in universities to determine its pedagogical quality and its ability to support the promotion of autonomy and critical thinking among students. These are just some of the points we have raised so that further studies can be proposed based on what has been discussed here.

Therefore, the integration of AI and higher education represents an opportunity to promote a more inclusive, adaptive, and effective education. It is the role of university professors and the entire academic community to seek ways to qualify the use of these and other resources in an ethical and critically reflective manner. The present and future challenges of intelligently integrating these technologies into higher education will be gradually reconfigured based on this user education. As we have seen from the beginning, it is human use that can make the machine a useful tool or a harmful weapon. For now, what can be glimpsed are significant advances in teaching and learning processes through optimization and the obvious need to train teachers and students for a world in constant (r)evolution, whether in the writing of academic texts or in the commitment to a more ethical and professional scientific doing/being.

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