AVALIAÇÃO
e-ISSN: 1982-5765 | Revista da Avaliação da Educação Superior
UNISO UNICAMP

Article

DOI: http://dx.doi.org/10.1590/1982-57652025v30id2864353

CHALLENGES AND OPPORTUNITIES OF ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: PERCEPTIONS OF FACULTY IN THE UNIVERSITY ENVIRONMENT

Desafios e oportunidades da Inteligência Artificial no Ensino Superior: Percepções dos Docentes no Ambiente Universitário

Desafíos y oportunidades de la Inteligencia Artificial en la Educación Superior: Percepciones del Profesorado en el Ambiente Universitario

Marcelle Feitoza Bassi Costa[1]
Orcid: https://orcid.org/0000-0002-3968-7183
E-mail: marcelle.bassi@pep.ufrj.br

Gabriel Orsi Tinoco[2]
Orcid: https://orcid.org/0000-0002-3297-0656
E-mail: tinocoorsi@gmail.com

Nicholas dos Santos Faria Corrêa[3]
Orcid: https://orcid.org/0009-0005-1478-4322
E-mail: nicholas.correa@pep.ufrj.br

Pedro Cariello Botelho[4]
Orcid: https://orcid.org/0009-0003-0490-1973
E-mail: pedrocbotelho@poli.ufrj.br

Tharcisio Cotta Fontainha[5]
Orcid: fontainha@pep.ufrj.br
E-mail: fontainha@pep.ufrj.br

Abstract: The advancements in AI have driven a new era of innovation and transformation in various contexts, including education. Thus, this study aims to investigate the primary opportunities and challenges of using AI in the university context from the perspective of graduate-level educators. To achieve this objective, a case study was conducted at the Graduate Program in Production Engineering (PEP) at COPPE/UFRJ. Two semi-structured interviews were conducted with the research area coordinators

[1] Universidade Federal do Rio de Janeiro | Rio de Janeiro | RJ | Brasil.
[2] Universidade Federal do Rio de Janeiro | Rio de Janeiro | RJ | Brasil.
[3] Universidade Federal do Rio de Janeiro | Rio de Janeiro | RJ | Brasil.
[4] Universidade Federal do Rio de Janeiro | Rio de Janeiro | RJ | Brasil.
[5] Universidade Federal do Rio de Janeiro | Rio de Janeiro | RJ | Brasil.

Received em: 10 maio 2024 | Approved em: 11 nov. 2024 | Revised em: 24 fev. 2025

Section Editor: Rafael Bunhi | Editor de Layout: Silmara Pereira da Silva Martins

within the program, in addition to searching for documents within the institution and analyzing the document "Brazilian Artificial Intelligence Strategy" (EBIA) from the Ministry of Science, Technology, and Innovation (MCTI). The results revealed that the main challenges identified were the risk of plagiarism, dependence on AI tools, a lack of critical reflection, and infrastructure and funding difficulties. However, it is worth noting that AI is recognized as a potential support for developing courses and administrative management facilitation. These findings provide valuable insights that can be considered to guide institutional strategies for adopting AI in higher education. Further research should be conducted to encompass other graduate programs and consider the perspectives of different stakeholders in the university environment, such as students and administrative staff, to enhance the understanding of the topic more comprehensively.

Keywords: artificial intelligence; higher education; opportunities and challenges.

Resumo: Os avanços da IA têm impulsionado uma nova era de inovação e transformação em diversos contextos, incluindo o educacional. Dessa forma, o objetivo deste estudo é investigar as principais oportunidades e desafios do uso da IA no contexto universitário sob a perspectiva docente no nível de pós-graduação. Para atingir esse objetivo, foi realizado um estudo de caso no Programa de Pós-graduação de Engenharia de Produção (PEP) da COPPE/UFRJ. Foram realizadas duas entrevistas semiestruturadas com os coordenadores das áreas de pesquisas que compõem o programa, além da busca por documentos na instituição e uma análise do documento "Estratégia Brasileira de Inteligência Artificial" (EBIA), do Ministério da Ciência, Tecnologia e Inovação (MCTI). Os resultados evidenciaram que os principais desafios levantados foram o risco de plágio, a dependência das ferramentas de IA, a falta de reflexão crítica e as dificuldades de infraestrutura e financiamento. Entretanto, destaca-se que a IA é reconhecida como um potencial apoio para o desenvolvimento de disciplinas e a facilitação da gestão administrativa. Tais resultados representam importantes insights que podem ser considerados para orientar estratégias institucionais voltadas para a adoção da IA na educação superior. Pesquisas futuras devem ser realizadas para abranger outros programas de pós-graduação e considerar a perspectiva de outros atores do ambiente universitário, como estudantes e funcionários administrativos, a fim de enriquecer a compreensão do tema de maneira mais abrangente.

Palavras-chave: inteligência artificial; ensino superior; oportunidades e desafios.

Resumen: Los avances en la inteligencia artificial (IA) han impulsado una nueva era de innovación y transformación en diversos contextos, incluyendo la educación. Por lo tanto, el objetivo de este estudio es investigar las principales oportunidades y desafíos del uso de la IA en el entorno universitario desde la perspectiva de los docentes a nivel de posgrado. Para lograr este objetivo, se realizó un estudio de caso en el Programa de Posgrado en Ingeniería de Producción (PEP) de COPPE/UFRJ. Se llevaron a cabo dos

entrevistas semiestructuradas con los coordinadores de las áreas de investigación que conforman el programa, además de la búsqueda de documentos en la institución y un análisis del documento "Estrategia Brasileña de Inteligencia Artificial" (EBIA) del Ministerio de Ciencia, Tecnología e Innovación (MCTI). Los resultados revelaron que los principales desafíos identificados fueron el riesgo de plagio, la dependencia de las herramientas de IA, la falta de reflexión crítica y las dificultades de infraestructura y financiamiento. Sin embargo, cabe destacar que la IA es reconocida como un apoyo potencial para el desarrollo de asignaturas y la facilitación de la gestión administrativa. Estos hallazgos proporcionan ideas valiosas que pueden considerarse para orientar las estrategias institucionales para la adopción de la IA en la educación superior. Se deben realizar investigaciones adicionales para abarcar otros programas de posgrado y considerar las perspectivas de otros actores universitarios, estudiantes y personal administrativo, para mejorar la comprensión del tema de manera integral.

Palabras clave: inteligencia artificial; enseñanza superior; oportunidades y desafíos.

1 INTRODUCTION

Artificial Intelligence (AI) has become increasingly present in our daily lives, significantly impacting how we interact with the world (Adiguzel; Kaya; Cansu, 2023). Although AI development dates back to the 1950s, it is in the present day that its applications have experienced tremendous growth due to the exponential increase in data and the rapid connectivity of high-performance computers (Kuleto *et al.*, 2021).

A recent study conducted by Hibou (Mello, 2023), revealed that 87% of Brazilians have heard of AI, and over 50% believe it is already impacting their lives somehow. This scenario is not much different in the educational context, where AI plays an increasingly significant role. According to Razia, Awwad and Taqi (2022), the incorporation of AI into higher education is an increasingly present reality and is seen as an opportunity to enhance the quality of teaching.

However, despite the growing presence of AI in universities, few studies explore its potential and challenges in this context (Renz; Hilbig, 2020). Moreover, the launch of ChatGPT in 2022 played a pivotal role in expanding access to and the use of AI. According to Adiguzel, Kaya and Cansu (2023), since then, ChatGPT has been recognized as a highly relevant tool for students and professionals in various fields.

Considering the need to assess the impacts of these AI technologies in higher education, this study aims to investigate the main opportunities and challenges of using AI in the university context from the faculty's perspective, specifically at the graduate level. The research was developed based on a case study conducted in the Production Engineering Program (PEP) of the Alberto Luiz Coimbra Institute of Graduate Studies and Research in Engineering (COPPE) at the Federal University of Rio de Janeiro (UFRJ). The choice of this specific program is justified by its relevance to engineering.

This case study fills a gap in the research by providing an in-depth perspective on the impacts of AI in a specific context, generating relevant insights to improve the quality of teaching and guide institutional strategies.

2 THEORETICAL FRAMEWORK

2.1 Artificial intelligence in education

Although AI technology has been the subject of study and scientific interest for more than six decades, its practical applications for education have been developed only recently (Russell; Norvig, 2010). Researchers such as Bates (2015), Renz and Hilbig (2020), and Tavares, Meira and Amaral (2020) highlight that the first attempts to replicate the teaching process using AI emerged in the 1980s. Since then, Artificial Intelligence in Education (AIED) has established itself as an academic research field, introducing new tools into the educational environment with the potential to significantly transform traditional teaching and learning methods.

One of the most common definitions of AI in education (AIED) was proposed by Popenici and Kerr (2017). According to these authors, AIED refers to "computational systems capable of engaging in human-like processes such as learning, adaptation, synthesis, self-correction, and the use of data for complex tasks" (Popenici; Kerr, 2017).

Based on this concept, AI technologies have had a significant impact on the educational process, especially with the emergence of new functionalities, such as recommendation systems that provide personalized instruction; intelligent tutoring systems that offer instant feedback; and automated assessment systems (Adiguzel; Kaya; Cansu, 2023; Ouyang *et al*., 2023; Tavares; Meira; Amaral, 2020).

As pointed out by Malmström, Stöhr and Ou (2023), higher education students are increasingly immersed in an environment influenced by AI, both in their academic and daily lives. This means that today's university students can experience an interactive and personalized learning environment thanks to AI applications. At the same time, instructors can explore new teaching methods, identify different learning styles of students, and provide personalized guidance, adapting their methods according to the individual needs of each student (Kuleto *et al*., 2021). However, Silveira and Vieira Junior (2019), when analyzing the structure of federal and state learning environments, show that there is a technological gap that depends on the public sector for expanding data communication and infrastructure. Therefore, exploring the possibilities of AI is conditioned by structural improvements that allow for its successful implementation (Silveira; Vieira Junior, 2019). In this sense, Renz and Hilbig (2020) observe that successful and sustainable cases of AIED implementation in higher education are still very scarce.

Furthermore, Adiguzel, Kaya and Cansu (2023), argue that although AI has the potential to revolutionize education, achieving positive educational outcomes requires more than just the use of advanced technologies. The application of AI in education

must be aligned with educational and learning theories, guiding instructional design and technological progress.

A recent and controversial advancement in AIED is using chatbot systems to assist in teaching and learning activities. These intelligent agents can interact with users, answering questions and providing appropriate responses (Adiguzel; Kaya; Cansu, 2023). One of the most well-known examples of a chatbot, nowadays, is ChatGPT.

2.2 Generative artificial intelligence

Lecun, Bengio and Hinton (2015) indicate that AI is based on deep learning, which allows computational models with multiple processing layers to learn data representations at various levels of abstraction. These methods have significantly improved the state of the art in areas such as speech recognition, visual object recognition, object detection, and drug discovery. According to the authors, using the backpropagation algorithm, deep learning adjusts internal parameters to uncover complex structures in large datasets. Furthermore, deep convolutional networks are effective in processing images, videos, speech, and audio, while recurrent networks are suitable for sequential data, such as text and speech.

Banh and Strobel (2023) explain that this deep learning serves as the foundation for what has come to be known as generative AI, a tool used by users through simple commands to produce new and realistic content across a wide spectrum (e.g., texts, images, or programming code). One example of a generative AI tool is GPT (Generative Pre-trained Transformer), a Natural Language Processing (NLP) model that uses deep learning to enhance its outputs (Adiguzel; Kaya; Cansu, 2023; Barbosa; Portes, 2023; Benevento; Meirelles, 2023). Developed in 2018 by OpenAI, a research organization in AI, the GPT model has undergone several updates, resulting in its most well-known version, ChatGPT. This version was specifically designed for human interaction and has since been widely used in chat applications and services to provide coherent and fast information to users (Velásquez, 2023).

The functioning of ChatGPT is based on a pre-training process in which the model is exposed to large quantities of textual data from various sources, such as articles, websites, books, and written conversations. During pre-training, GPT learns to predict the next word in a sentence or complete a sentence meaningfully, thereby improving its ability to generate cohesive and semantically accurate texts (Benevento; Meirelles, 2023).

According to Barbosa and Portes (2023), the incorporation of thousands of human language examples has allowed the technology to deeply understand the context of user requests, resulting in more accurate responses to demands.

ChatGPT has a wide range of functionalities, including language translation, text summarization, answering questions, creative writing, generating high-quality content, and correcting errors in existing code or generating new code (Eke, 2023). According

to Adiguzel, Kaya, and Cansu (2023), these functionalities make ChatGPT a valuable tool in various fields, becoming a relevant resource for students and professionals.

However, like any system, ChatGPT is not without flaws. Some of the main challenges raised by Adiguzel, Kaya and Cansu (2023) and Velásquez (2023) regarding the development and programming of chatbots based on generative AI include the fact that the accuracy of the responses provided by the chatbot is intrinsically linked to the quality of the input data. In other words, to obtain accurate responses, users need to provide precise input data. Additionally, despite being highly accurate most of the time, ChatGPT can still make mistakes or provide imprecise and incorrect answers in some situations. It is important to mention that there are problems with the databases of these systems, which may be biased and not adequately meet users' real needs. Finally, there is the risk of the chatbot providing harmful instructions to users, such as sharing malware code, as well as potentially reproducing biases and inequalities present in the training data obtained from the internet.

In the educational field, the use of ChatGPT and other AI-powered text tools raises significant concerns about academic integrity (Eke, 2023). Stakeholders in higher education and scholars have raised questions about the advancement and influence of AI on teaching and learning, especially in the context of evaluation/exams and academic ethics (Malmström; Stöhr and Ou, 2023).

In this context, it becomes essential and urgent to analyze the main ethical and social challenges related to the use of this technology (Barbosa, 2023) to ensure sustainable and ethically sound academic practices.

3 ETHICAL ISSUES OF AI IN EDUCATION

The ethical issue of using ChatGPT in the era of AI is of utmost relevance (Silva, 2023). At the international level, an important document that provides guidelines and ethical principles for the development, deployment, and responsible use of AI is the 2022 Recommendation on the Ethics of Artificial Intelligence, published by UNESCO. This recommendation considers the "profound and dynamic impacts, both positive and negative, of AI on societies, the environment, ecosystems, and human lives" (UNESCO, 2022, p. 5), and aims to guide Member States in formulating national policies and strategies that promote ethics in the AI field.

In the educational context, a series of ethical challenges have been raised by various researchers (Adiguzel; Kaya; Cansu, 2023; Barbosa, 2023; Silva, 2023; Velásquez, 2023). First, the issue of privacy is a point of concern when using these technologies, as the chatbot may collect and store personal information from students. It is essential to emphasize the importance of the quality and accuracy of the information provided by GPT. The model may be trained with misleading or incorrect data, which represents a significant concern. This situation could lead to the dissemination of false information, with potentially negative consequences for society. Finally, being used as a tool

for analysis and writing, it presents some ethical dilemmas regarding copyright and intellectual property rights.

However, according to Velásquez (2023), there is no consensus on this point, as some authors believe that "the presence of chatbots as co-authors can be seen as a technological evolution and a way to speed up the research process" (Velásquez, 2023, p. 1).

More broadly, O'Neil (2017), discusses in her book Weapons of Math Destruction the ethical risks associated with AI algorithms in education. According to the author, algorithms used in education, such as student performance evaluation systems or course recommendation algorithms, can reproduce and amplify existing inequalities. For example, if these algorithms are trained with data that reflect historical biases, such as racial or economic disparities, they may continue to perpetuate these inequalities by recommending resources or decisions that benefit privileged groups and harm marginalized ones. In the same vein, Eubanks (2018), points out that the impact of automated systems in education often simplifies the complexity of learning and reduces education to quantitative metrics, ignoring the individual needs and social context of students.

According to Adiguzel, Kaya and Cansu (2023) and Velásquez (2023), to ensure the ethical and responsible use of AI in education, it is crucial to foster continuous debate on the positive and negative aspects of this technology, involving educators, researchers, and policymakers, as well as establishing guidelines and practices that promote academic integrity and mitigate potential risks associated with AI in the educational context.

4 METHODOLOGY

This research adopts a qualitative, interpretative approach based on the analysis of articles related to the topic of AI in higher education, as well as documents and regulations related to the field. Seeking to explore a unique university context and articulate the perception of faculty members regarding this scenario with the sources of evidence, this research follows the case study method proposed by Yin (2001). Thus, based on the stages of the case study methodology outlined by Yin (2001), the research followed these stages: (i) planning, (ii) design, (iii) preparation, (iv) evidence collection, (v) evidence analysis, and (vi) sharing results.

The case study is an empirical investigation "[...] that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly defined" (Yin, 2001, p. 32). The adoption of the case study method for this research is justified by its relation to the research scope—the faculty's perception of the opportunities and challenges of using AI in higher education—due to the current relevance of the topic and the increasing incorporation of AI into our society.

In the planning phase, the research question was formulated about the main opportunities and challenges of AI use at the university level, considering the faculty perspective at the postgraduate level. This question was developed based on research gaps identified in the existing literature. In the design phase, the chosen object of analysis was the Production Engineering Program (PEP) due to its academic excellence, pioneering spirit, and relevance in scientific and technological development in Brazil. Created in 1967, PEP is a pioneer in the country and promotes dialogue between the exact and natural sciences, social sciences, and health sciences. Its activities cover diverse topics, dedicating themselves to the conception and management of production systems involving people, materials, equipment, and the environment. These characteristics allow for the application of the generated knowledge across various sectors, including industry, agriculture, services, public administration, and social initiatives. Over its history, PEP has addressed technological advancements as opportunities for improving production systems, with generative AI being one of the latest technologies under discussion, not only within general production systems but also within the production system of higher education, both at undergraduate and postgraduate levels. Given PEP's recent history—achieving a rating of 4 ("Good") in the CAPES evaluation for the 2013-2016 period and 5 ("Very Good") for the 2017-2020 period—it is recognized that the program has made continuous efforts to improve its evaluation and acknowledges that modernizing its activities, whether through the incorporation of generative AI into its research lines or improving educational practices, is a path to maintain the continued increase of its CAPES rating in the current 2021-2024 period. Therefore, the choice of PEP as the object of study is justified by its interdisciplinary and comprehensive approach, which facilitates the integration of AI into multiple contexts and fosters an environment conducive to exploring the opportunities and challenges of this technology in postgraduate education.

During the preparation phase, two main sources of evidence were defined: (i) institutional documents related to PEP, COPPE, UFRJ, and the Ministry of Science, Technology, and Innovation (MCTI); and (ii) two semi-structured interviews with faculty members who serve as heads of the two concentration areas within PEP. In the university structure, area heads are considered the primary links between postgraduate faculty and the administrative and strategic units of the university. Thus, the two area heads of PEP are responsible for compiling the demands and actions of faculty members to be presented to the PEP coordination, which then leads to the COPPE directorate, which in turn leads to the Dean of the Technology Center and the Vice-Presidencies of UFRJ. These area heads are also responsible for supporting the incorporation of decisions that come from higher UFRJ bodies, including those regarding the use of AI at the university. Thus, the interviewees hold strategic positions across various fronts—from the classroom to administration. Furthermore, it is important to note that all ethical aspects related to the interviews, and the research as a whole, were clarified with the interviewees. Additionally, the commitment to confidentiality and anonymity

was reinforced, alongside the possibility for interviewees to withdraw from the research at any time.

The interview script was developed based on the literature review conducted during the design phase. The questions were organized into blocks and thematic groups to facilitate the analysis and coding process of the information. Table 1 presents the thematic groups used.

Table 1 - Thematic Groups of the Interview

Blocks	**Thematic Groups**	**Theoretical Framework**
Block 0	University professor profile	(N/A)
Block 1	Use of AI in teaching practice	Silveira and Vieira Junior (2019); Kuleto *et al*., (2021); Parreira; Lehmann; Oliveira (2021); Renz; Hilbig (2020); Brasil (2021)
Block 2	Training and regulatory knowledge of AI	Tavares, Meira and Amaral (2020); Renz; Hilbig (2020)
Block 3	Impacts of AI on teaching practice: challenges and opportunities	Eke (2023); Kuleto *et al*., (2021); Malmström, Stöhr, Ou (2023); ParreirA, Lehmann, OliveirA (2021); RenZ, Hilbig (2020); Silveira and Barros (2021)

Source: Author's own elaboration.

The data collection through documents was carried out on the websites of the entities mentioned during the month of April 2023. The interviews, on the other hand, took place in May 2023 via digital platforms (Google Meet and ZOOM). All interviews were recorded and transcribed to facilitate content analysis. It is important to note that, as this was a semi-structured interview, additional questions and follow-ups were made throughout the interviews to track the ideas presented by the interviewees and explore the aspects they raised. Furthermore, at the end of the interview, the participants were free to propose suggestions, ideas, and clarify issues that were not necessarily asked, but that they considered relevant to the debate, to complement their views on the topic of AI in the educational context and, specifically, in the PEP postgraduate program.

The analysis was based on the pattern adequacy technique defined by Yin (2001). Thus, the collected information was categorized and analyzed according to the

four thematic groups presented in Table 1, which corresponds to the theoretical framework in Section 2. Each thematic group was elucidated through the categorization of the articles that composed the theoretical framework. These groups were: (a) the use of AI in teaching practice; (b) training and normative knowledge about AI; and (c) the impacts of AI on teaching practice: challenges and opportunities. For each theme, triangulation was performed between the theoretical framework, the interviewees' statements, and excerpts from the EBIA, especially those related to the transversal and vertical axes that interacted with the results. This triangulation allows for an understanding of what is encompassed in the scientific literature by cross-referencing this information with the perceptions of actors experiencing the context and with the government's strategic document, which serves as a guideline for the insertion of AI into Brazil's productive systems.

Finally, the sharing of results was detailed in the results and final considerations sections of this work, focusing on professionals and researchers interested in the development of studies and research on higher education. In this sense, it is essential to highlight the limitations of this study, which is based on the analysis of a specific postgraduate program from COPPE/UFRJ and the perceptions of selected actors. Therefore, generalization to undergraduate programs, other postgraduate programs, and other educational contexts should be done cautiously, as generally indicated by Yin (2001). Some variables to consider in this regard may relate to the hierarchical position of the interviewees in this study (i.e., heads of knowledge areas), which may differ from other positions (e.g., student/researcher, coordinator, vice-rector, etc.), knowledge area, and level of education (e.g., short courses, undergraduate, specialization). Nevertheless, it is important to also recognize that the results obtained from the triangulation between documents, interviews, and scientific literature allow for the initiation of discussions on the introduction of AI in the educational environment from a specific case but directed towards broader discussions. Therefore, it is recommended that further studies be conducted that broaden the discussion in other cases and contexts to identify and validate broader opportunities and challenges. Such research can provide a foundation for restructuring and developing policies for the adoption of AI in the context of higher education, both at the undergraduate and postgraduate levels.

5 RESULTS

Initially, documentary research was conducted on the university's institutional website to investigate the relationships between AI and the context of postgraduate studies in the PEP, COPPE, and UFRJ. UFRJ has a hierarchical structure in which the Pro-Rectorate of Postgraduate Studies supports 11 university centres, with the Center for Technology (CT) being one of them. COPPE, one of the five units of the CT, houses the PEP, which is one of the 13 postgraduate programs at COPPE. However, no documents

directly addressing this theme were found, indicating the absence of direct evidence of the use or discussion of AI within PEP.

However, in 2020, the document "Brazilian Strategy for Artificial Intelligence" (EBIA), endorsed by Portaria MCTI No. 1.122/2020, established AI as a government priority. The EBIA outlined strategies for research projects, technology development, and innovations related to AI from 2020 to 2023 in Brazil (Brasil, 2021). Since PEP is a federal postgraduate program, this document has the potential to directly impact PEP/COPPE/UFRJ, as it encompasses the axes of "education" and "research, development, innovation, and entrepreneurship", as well as addressing transversal issues of "legislation, regulation, and ethical use" (Brazil, 2021, p. 16-34).

To ensure a consistent analysis, triangulation was conducted between the information from the EBIA, the interview responses, and the articles in the theoretical framework of this paper. The results, subdivided into three relevant categories, are presented in three groupings: (a) use of AI in teaching practice, (b) training and normative knowledge about AI, and (c) challenges and opportunities of AI in teaching practice.

a) The Use of AI in teaching practices

AI technologies have had a significant impact on the field of education, as evidenced by resources such as recommendation systems, intelligent tutoring, and automated assessment (Adiguzel; Kaya; Cansu, 2023; Ouyang *et al*., 2023; Tavares; Meira; Amaral, 2020). In this context, the EBIA document emphasizes that AI will impact the Research, Development, and Innovation environment as a facilitator of new discoveries and scientific advancements through its ability to process large volumes of data, identify patterns, explore hypotheses, and make inferences that are beyond the capabilities of humans (Brasil, 2021).

In this regard, **Interviewee 1** highlights that the use of AI can bring significant advances in teaching practice, particularly in the development of courses, the creation of case studies, the development of virtual scenarios, and a search tool. According to him, "*AI should be applied to assist in the development of new challenges, as a tool for searching specific topics, in the creation of virtual realities, and mapping market demands for inclusion in course content*."

On the other hand, **Interviewee 2** presents the perspective that AI should be used, as long as it always prioritizes the pedagogical approach and serves as a facilitator to enhance the university's educational mission, without specifying how this usage could be materialized. For him, "[...] *AI should be used if it frees students and professors to fulfil their ultimate missions, which are to learn and to teach. I don't have answers about the conditions under which this can happen*."

The interviewees also emphasize that AI can assist students in the context of research development, as an intelligent tutoring system or a recommendation system. "*When you're starting from scratch, and you want to relate two things that you don't even know where to begin*" **Interviewee 2**. In this perspective, "*I believe these tools can*

be used to support students, assist in research, and summarize large amounts of content" **Interviewee 1**.

However, **Interviewee 1** draws attention to contexts where AI should not be used in research due to ethical concerns that touch upon critical development and dependence on tools. For him, "*[AI] should not be applied in the activity of reflection and creation itself (...) we would then have an ethical problem because the professional or student might become dependent on the insights and 'starts' that AI can promote*."

On the ethical front, the EBIA states that AI should "promote mechanisms that encourage the development of AI systems that adopt ethical principles and values" (Brasil, 2021, p. 36).

Table 2 presents the triangulation of interview data, the theoretical framework, and the EBIA to enrich and synthesize our understanding of the use of AI in the educational context.

Table 2 - Triangulation of Information on the Use of AI in Teaching Practice

Theoretical Framework	Interviews	EBIA
Recommendation Systems	"[...] AI should be applied to assist in developing new challenges, as a tool for searching specific topics, creating virtual realities, and supporting market demand mapping to incorporate these into course syllabi."	Vertical Axis: Research, Development, Innovation, and Entrepreneurship Ability to Process Large Volumes of Data
Intelligent Tutoring	"When you are starting from scratch and want to relate two things but don't know where to begin." "[...] I believe these tools can be used as supporting for students, helping with research and summarizing large amounts of content."	Vertical Axis: Research, Development, Innovation, and Entrepreneurship Facilitator of New Discoveries and Scientific Advancements
Automated Assessment		Vertical Axis: Research, Development, Innovation, and Entrepreneurship Exploring Hypotheses and Making Inferences Beyond Human Capacity

Source: Author's own elaboration

The opportunities prescribed by the interviewees confirm many positive aspects and potentials of AI in education, as highlighted in the theoretical framework and the EBIA. However, no actual AI practices are presented, with concerns primarily focused on ethics, and there are reservations regarding its implementation. Thus, the scarcity of successful and sustainable cases of AIED in higher education, emphasized by Renz and Hilbig (2020), is confirmed by the prescriptive approach of the interviewees, who do not specify instances of AI in the teaching practice of the Production Engineering Program at COPPE itself. Therefore, these analyses also support the ideas of Silveira and Vieira Junior (2019), who highlight that technological lag in state and federal learning environments is an issue that hinders the successful implementation of AI practices in this context.

b) Training and normative knowledge on AI

Tavares, Meira and Amaral (2020), assert that the implementation of AI in the educational field must be planned, gradually, and emphasize supporting teaching, avoiding the automation of the educational process. This includes the training of professionals working in this area, through the development of the technical skills necessary to interact with and take advantage of the possibilities that AI can offer them (Brasil, 2021). However, the interviewees stated that they had not participated in any specific training on the topic and were unaware of any regulations or guidelines that directly or indirectly impacted them. It is important to note, however, that the interviewees acknowledge some activities related to open debates and experimentation on the subject within the university, especially regarding ChatGPT.

According to **Interviewee 1**, "*there were some debates [on the topic], but they did not result in any regulations or guidelines. Regarding COPPE, we don't have anything consolidated*." **Interviewee 2** states, "*I haven't received any communication about it yet. I think we are still in the initial stages, with lectures and beginning a reflection on the topic*."

Table 3 highlights how information from various sources converges to provide a more complete and accurate view of AI training and related regulatory guidelines.

Table 3 - Triangulation of Information on Training and Normative Knowledge about AI

Theoretical Framework	Interviews	EBIA
Tavares, Meira, and Amaral (2020) emphasize the importance of implementing AI in the educational	"[...] there were some discussions [on the topic], but they did not result in regulations or guidelines.	Vertical Axis: Education

Theoretical Framework	Interviews	EBIA
field in a planned, gradual manner, with a focus on supporting teaching and avoiding the automation of the educational process.	At Coppe, we don't have anything established."	Professional training in this field involves the development of technical skills needed to interact with and make full use of AI's potential
	"[...] I haven't received any notification about it yet. I think we're still in the early stages of discussion, with lectures and just starting to reflect on this."	

Source: Author's own elaboration

The triangulation reveals that the interviewees confirm the need for training and the development of technical skills for the integration of AI in education, as advocated by the theoretical framework. However, the lack of specific training and limited knowledge of regulatory guidelines indicates a disconnect between theoretical guidelines and institutional practice at the university. Informal activities, such as debates and experimentation, complement but do not replace the structured and planned implementation suggested by the EBIA and researchers like Tavares, Meira and Amaral (2020).

c) Challenges and opportunities of AI in teaching practices

The research findings reveal a series of challenges and opportunities that arise with the application of AI in teaching practice. Regarding the challenges, it is important to highlight that the use of technologies such as ChatGPT and other AI-based text generators poses risks to academic integrity and generates issues related to the originality and authenticity of academic work (Eke, 2023). In this sense, **Interviewee 1** emphasizes that the challenges are precisely related to plagiarism: "*[...] you can identify that the work is the initial one, and the person took the idea from somewhere as inspiration, but sometimes they take everything, and that's an ethical issue. Was it really done, did I use it, or did I just copy it? We still don't know how to map this yet*."

Silveira and Barros (2021), discuss the challenge of motivating students and aligning teaching and research practices with the high availability of knowledge from these tools. In this context, **Interviewee 2** speaks about the changing role of the teacher and how they bring themes into the classroom. According to him, "*In the classroom, in teaching, I really think the role of the teacher has changed. Since I entered university and became aware of this, I said: chalk doesn't work anymore... I'll start talking about an author, and the person will open Wikipedia and read about the author, and*

they'll know more about them faster than I can talk. Or from an authorized source, like Stanford, for instance."

It is worth noting that despite the EBIA advocating for the idea of "expanding research, development, innovation, and the application of AI by enabling the provision of specific resources for this topic and coordination between existing initiatives" (Brazil, 2021, p. 35), **Interviewee 1** still views the lack of university infrastructure, the absence of full-time students, and limited funding for projects addressing the theme as challenges. According to him, "*We've had a latent infrastructure problem for some years, especially if we want to start talking about artificial intelligence. We don't have infrastructure preparedness, given that the internet itself is not robust, even when thinking about something more interactive with the students. [Additionally], another challenge would be the lack of an office at Coppe to capture, maintain, and manage projects so we could offer the student a scholarship that would allow them to do the program full-time (studying and developing)*."

Regarding opportunities, Malmström, Stöhr and Ou (2023) argue that the contemporary university context has the potential to experience an interactive and personalized learning environment, thanks to AI applications. In this context, both interviewees highlight how AI could assist in interactivity and the facilitation of managerial, administrative, and routine processes within the university, saving teachers' time and increasing the university's managerial efficiency. **Interviewee 2** emphasizes, "*If I had a scenario where AI helped me with administrative tasks, allowing me more time to dedicate to the core activities, it would be wonderful. [...] Freeing me from administrative tasks [since] my role is to guide the students!*"

Similarly, **Interviewee 1** states that AI could provide more efficient systems for managing routines and academic follow-ups with students. "*Today, for example, discovering the deadlines and information of each student is a huge task. I don't have all the advised students registered in SIGA, and that would be a tool that could already be developed*" **Interviewee 1**.

In parallel, Kuleto *et al*., (2021) emphasize that AI provides new opportunities for teachers to explore different teaching methods, identifying students' individual learning styles and offering personalized guidance. Additionally, the EBIA "proposes establishing connections and partnerships between the public sector, private sector, scientific institutions, and universities for advancing the development and use of AI in Brazil" (Brasil, 2021, p. 35). In this sense, the interviewees discuss how the use of AI could foster learning dynamics. According to **Interviewee 1**, "*The main opportunity would be bringing real-life scenarios into the classroom. For professional purposes, development, and even everyday management, in the classroom. I've used ChatGPT myself to generate some case studies for the undergraduate course, and it helps bring more up-to-date material*."

Interviewee 2, on the other hand, believes that AI can have educational functions, such as "'*opening the mind' or presenting things that don't require creativity, invention, or creation in general [...] it [AI] can integrate into educational processes, but in that way*."

Beyond opportunities, the ideas raised by the interviewees previously already indicate and relate to the perspective of a new teaching dynamic, based on new ways of constructing the educational process and, why not, the roles of each actor within the classroom. In line with this, the EBIA reinforces, regarding qualifications for a digital future, the need for "innovative pedagogical practices and the importance of re-signifying teacher training processes to address the challenges arising from the inclusion of technology and AI as a pedagogical tool in the classroom" (Brazil, 2021, p. 28).

In Tables 4 and 5, we highlight the triangulation of information to enrich the understanding of the challenges and potentialities (respectively) associated with the integration of AI in education.

Table 4 - Triangulation of Information on the Challenges of AI in Teaching Practice

Theoretical Framework	**Interviews**	**EBIA**
Regarding challenges, it is important to highlight that using technologies like ChatGPT and other AI-based text generators poses risks to academic integrity, raising issues related to originality and authenticity in academic work (Eke, 2023).	"[...] Was it actually done, did I use it, or did I simply copy it? We still don't know how to map this out yet."	Transversal Axis: Legislation, Regulation, and Ethical Use Regulatory structures on the protection and application of intellectual property rights (IPR). The primary concern is copyright.
Silveira and Barros (2021) discuss the challenge of motivating students and aligning teaching and research practices with the high availability of knowledge from these tools.	"In the classroom, in teaching, I really think the professor's role has changed [...]"	Vertical Axis: Education Digital educational resources, adaptive platforms, innovative pedagogical practices, and the importance of redefining teacher training processes to address the challenges arising from the integration of technology

Theoretical Framework	Interviews	EBIA
		and AI as pedagogical tools in the classroom.
	"We have faced significant infrastructure challenges for years, especially if we want to start discussing artificial intelligence."	Vertical Axis: Research, Development, Innovation, and Entrepreneurship Expanding research, development, innovation, and AI application opportunities through the provision of specific resources for this topic and the coordination of existing initiatives.

Source: Author's own elaboration

Table 5 - Triangulation of Information on AI Opportunities in Teaching Practice

Theoretical Framework	Interviews	EBIA
Malmström, Stöhr and Ou (2023) suggest that contemporary university settings can experience an interactive and personalized learning environment thanks to AI applications.	"If I had a scenario where AI could assist me with administrative tasks, allowing me to dedicate more time to core activities, it would be wonderful. (...)"	Vertical Axis: Education Establishment of pilot programs that use AI to enhance the efficiency of governance, service provision, and public administration.
Kuleto *et al.*, (2021) highlight that AI offers new opportunities for teachers to explore diverse teaching methods, identify students' individual learning styles, and provide personalized guidance.	"Today, for instance, finding deadlines and information for each student takes considerable time. I don't have all advised students recorded in SIGA [Sistema Integrado de Gestão Acadêmica, in Portuguese; Integrated Academic Management System, in English], and such a tool could already be developed."	Vertical Axis: Research, Development, Innovation, and Entrepreneurship Fostering a public policy environment that supports a quick transition from the R&D

Theoretical Framework	Interviews	EBIA
	"(...) it would bring real-life situations into the classroom. (...). I used ChatGPT to generate some case studies for the undergraduate course, which also helps bring in more recent information."	phase to the development and operationalization of AI systems. Governments can provide funding to support the development and adoption of emerging technologies with practical applications in the public sector.
	"'Opening minds' or presenting content that doesn't require creativity, invention, or creation in general (...) AI can integrate into educational processes but in this way."	

Source: Author's own elaboration

Thus, from the triangulation of the information in Tables 4 and 5, it was possible to verify that the interviewees confirm and complement the ideas presented in the theoretical framework and the EBIA. They emphasize the challenges identified in the theoretical framework, especially regarding academic integrity (Eke, 2023), the changing role of the teacher (Kuleto *et al*., 2021), and infrastructure issues (Malmström; Stöhr; Ou, 2023). At the same time, they complement the highlighted opportunities, reinforcing the potential of AI to create interactive learning environments and improve administrative and academic efficiency.

6 CONCLUSION AND FINAL CONSIDERATIONS

The application of AI in teaching practices presents both challenges and opportunities. Firstly, the research found the absence of institutional documents and specific training on the use of AI in academia, as well as technological lag. This context is considered a major challenge for the development and implementation of AI in the university setting and highlights the lack of existing practices in the program. Other challenges identified include the risk of plagiarism, dependence on AI tools, the lack of critical reflection in the creation process, and difficulties related to infrastructure and funding within the university. Despite these challenges, the research results indicate that the potential of AI in teaching practices is related to the development of courses, case creation, virtual scenario building, and its role as a facilitator in managing routine tasks and administrative activities.

It is crucial to highlight that AI is not limited to teaching practices but also plays a key role in university administrative practices. The interviewees emphasized that AI could be an ally in managing administrative processes, helping to optimize resources and time. This intersection between AI and university administration underscores the need for specific guidelines that govern both AI use and Information and Communication Technologies (ICT). However, the lack of these specific guidelines has resulted in a unified approach by faculty, treating both subjects in an integrated manner in the absence of separate strategies.

Considering this finding, it becomes evident that the university should direct institutional investments into initiatives involving AI. Such an approach would align not only with the strategic guidelines of the EBIA, which aims to expand research and development possibilities through AI, but also with the practical needs of faculty and university administrators. Therefore, it is proposed to promote continuous discussions, implement specialized training, establish clear programmatic guidelines, and create funded research hubs, to encourage the responsible and ethical adoption of AI in the educational context.

As the next steps, it is suggested to conduct further investigations encompassing other graduate programs, as well as considering the perspectives of other actors within the university environment, such as students and administrative staff. This approach aims to broaden the understanding of the opportunities and challenges present in this context, providing a more comprehensive perspective.

ACKNOWLEDGEMENTS

The authors acknowledge the support of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) [88881.717009/2022-01, Finance Code 001].

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Author Contributions

Marcelle Feitoza Bassi Costa – Conceptualization, project administration, literature review, data analysis, discussion of results, writing – review and editing.

Gabriel Orsi Tinoco – Conceptualization, project administration, literature review, data analysis, discussion of results, writing – review and editing.

Nicholas dos Santos Faria Corrêa – Conceptualization, data collection, data analysis, discussion of results, writing – review and editing.

Pedro Cariello Botelho – Conceptualization, data collection, data processing, data analysis, discussion of results.

Tharcisio Cotta Fontainha – Research supervision regarding objectives, methodological procedures, literature review, and text revision.

Reviewed and translated by
Marcelle Feitoza Bassi Costa

Email: marcelle.bassi@pep.ufrj.br.
Tharcisio Cotta Fontainha
E-mail: fontainha@pep.ufrj.br.