

Enhancing Higher Education in Portugal: Leveraging Generative Artificial Intelligence for Learning-Teaching Process

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Abstract: Recent advancements in Generative Artificial Intelligence (GAI) have revolutionized numerous fields, including higher education. This study focuses on the integration of GAI in Portuguese higher education institutions and explores its multifaceted implications and potential. Our research, conducted through a comprehensive survey between April and June 2023, engages with higher education faculty to understand their perceptions and utilization of GAI tools in teaching and learning processes. The potential of GAI to enhance personalized learning and interactive teaching methodologies is significant. It enables the creation of customized educational content, interactive simulations, and real-time feedback mechanisms, thus reducing the educators' workload and enhancing the learning experience. However, this integration is not without challenges. The study identifies critical ethical concerns around the use of GAI, including issues related to data privacy, intellectual property, and the potential for bias in AI-generated content. Additionally, our findings indicate a varying degree of acceptance and readiness among educators to adopt these technologies. While some express enthusiasm for the potential of GAI to transform educational practices, others remain cautious, highlighting the need for comprehensive training and support to fully leverage GAI capabilities. This paper captures the essence of the study's findings, which illustrate both the promising opportunities and the complex challenges associated with the use of Generative AI in higher education. By addressing these challenges and fostering an informed and ethical approach to GAI integration, higher education institutions can significantly enhance teaching and learning landscapes.

Keywords: Generative AI (GAI), Higher education, Personalized learning, Ethical implications, Educational outcomes

1. Introduction

Major recent breakthroughs have been reported in the field of generative artificial intelligence, which has significantly impacted the AI status quo. GAI systems are part of machine learning, deep learning, and natural language processing systems that generate content forms across texts, audio, videos, software codes, and simulations. These systems require a considerable amount of data to be fed into their systems of deep neural networks to recognize patterns in multimedia and create new materials based on the principles of probability.

As Shanahan (2022) noted, Large Language Models (LLMs) are "generative mathematical models of the statistical distribution of tokens in the vast public corpus of human-generated text, where the tokens in question include words, parts of words, or individual characters including punctuation marks. They are generative because we can sample from them, which means we can ask them questions." All these models have been trained on colossal human text, which enables them to generate natural language text using statistical and information-theoretic methods and machine learning.

These features in the evolution of LLM demonstrate how they can be interacted with by people through prompts for free text, thus predicting a new era that may be especially relevant in higher education to professors and students. Although some guidance in the writing process is possible through some of the existing tools, the introduction of this tool, which can replace the writing process creatively, represents a paradigm shift and provides new ways to improve learning and teaching. GAI, using DL and NLP techniques, can autonomously create learning materials, quizzes, and interactive simulations for each student, leading to deep involvement in the topic and understanding and personal performance in the topic of a learner without heaping more load on professors. These educators can be relieved of some duties by automating the grading, providing real-time feedback, as well as supporting administrative and pedagogical tasks. GAI has countless potentialities in education, promising a horizon full of new possibilities for the future of learning.

However, despite all the bright promises of GAI in education, there has yet to be a debate about the issues of trustworthiness, credibility, and comprehensibility of its outputs. This discussion claims that further research

should be careful, particularly in education (Crawford, Cowling, and Allen, 2023). Further, the broad adoption of GAI in higher education prompts questions and serious concerns associated with ethics, including algorithmic bias, data privacy, and the ownership of intellectual property rights. We would have to introduce GAI into education with a very responsible and ethical approach that would allow the benefits to be fully gained and the potential drawbacks to be averted.

The present paper aims to adapt GAI to higher education institutions in Portugal. The online survey period was conducted from April 1, 2023, to June 30, 2023. The collected data were subjected to descriptive and inferential analysis processing by IBM SPSS 29.0. From the identified perspectives of the teaching-learning activity, the frequency and purpose of GAI utilization by higher education instructors are identified, as is the identification of trends and future application of GAI in academia. It is also true that, for the adaptation of this idea to GAI in higher education institutions in Portugal, this research tries to base a theoretical framework to guide strategic options regarding the improvement of educational practices. This infers that GAI has the capability to significantly revolutionize methodologies to be applied in teaching-learning process but touches more on ethical considerations that all educational technologies based on AI are used in a way that is just and fair.

2. Background and Related Works

It belongs to the subclass of Machine Learning (ML) models and generates new data points within a given dataset by learning its structure and distribution. Applied to various fields such as image synthesis, natural language processing, and music composition, it has become the center of attention more often (van den Oord et al., 2016).

However, due to the wide prevalence and ever-evolving character of GAI, there remains a need for some articulation regarding its definition and the mechanisms of operation. GAI can produce text, images, video, music, and complex, sophisticated human-like content. These systems are designed to detect and mimic patterns, styles, and structures they are presented with. However, the primary concern about biases in the training processes is reliance on data quality and subjectiveness. The models might pick up human biases that are unnoticeable to them and affect the outcome. Furthermore, the training process generally exposes individuals to the harmful elements of the Internet. More so, the welfare of such individuals who might be involved in annotation and data refinement raises ethical concerns.

Since 1980, artificial intelligence began to enter education, changing the direction of the use of technology in educational practice. (Sleeman and Brown, 1982). Now, AI consists of machine learning, neural networks, and natural language processing techniques, among all other ways of simulating cognitive processes in human beings (Akgun and Greenhow, 2022). Luckin (2017) argues that AI can substantially contribute to personalizing student and teacher learning. Using other technologies has made machine learning a mainstay in AI, enabling less dependency on human intervention.

The applications are very different from each other: they range from product recommendations to disease detection. In education, meanwhile, the infusion of AI offers insights into student progress and solutions to learning disparities. There has been considerable attention paid to GAI regarding the next step in ML capabilities since the early 2010s, as it allows the development of new content based on input. There is growing interest in integrating GAI into the educational process. Despite the exponential growth of such tools, research regarding teachers' perceptions of integrating Generative AI tools, such as ChatGPT, within curricula is still at the periphery. Understanding teachers' attitudes towards such technologies is vital in the process of their incorporation into the educational system. This area thus calls for more investigation.

GAI is considered a novel, fast-evolving domain poised to impact higher education with new opportunities and challenges on multiple dimensions. Therefore, the scope of this literature review is to synthesize recent research findings and identify key themes and group papers to draw an overview of GAI's impact on higher education. In this sense, he built a search string and used it in the Scopus database: with a search period from 2022 to date, it obtained only 31 papers on "Generative Artificial Intelligence", "Higher education", and "teaching". However, the total results amount to zero when the expression "Portugal" is added to the search string. So, this section discusses the findings from the analysis of 31 papers located globally. The paper analysis identified five clusters: awareness, adoption, and usage of GAI in higher education; pedagogical implications and educational benefits; ethical challenges and academic integrity; student perspectives and engagement; faculty training and professional development.

GAI Awareness, Adoption, and Usage in Higher Education: Most research work by different researchers across the globe, for example, (Yusuf, Pervin, and Román-González, 2024; Alammari, 2024; Umme et al., 2024),

reiterates an increasing trend in awareness and intention to use GAI tools on the part of educators. Survey data show readiness and motivation on the part of educators to adopt GAI as it is likely to be a high potential area for collaborative learning, professional development, and personalized methodologies in teaching. However, the literature regarding this fact is lacking, and therefore, more empirical research studies are needed to fully exploit the effect GAI might have on teaching and learning (Bannister, Urbieto and Peñalver, 2023).

Pedagogical Implications and Educational Benefits: In their works, Koh et al. (2024), Salinas-Navarro et al. (2024), and Billingsley and Gardner (2024) demonstrate that GAI will genuinely enhance the teaching and learning experience through the adoption of new pedagogical strategies, new forms of authentic assessment, and new ways of personalizing learning. This general artificial intelligence will benefit second-language learners and bilingual students by improving language acquisition and fostering educational growth.

Ethical Challenges and Academic Integrity Ethical challenges are another recurring concern in most literature on GAI in HE. For example, (Bozkurt, 2024; Sullivan, Kelly & McLaughlan, 2023; Moya & Eaton, 2023). If academic integrity, plagiarism detection, and AI model bias are vital concerns, then transparent integration guidelines and practices in the ethical use of AI are required. To fully realize GAI, one must be careful about ethical implications and ensure compliance with copyright laws.

Student Perceptions and Engagement: Student input is one of the most profound inputs in altering the outlook for implementing GAI tools within higher education (Chiu, 2024; Yang et al., 2024; Lemke et al., 2023). Studies have noted the reinforcement of learning outcomes, student agency, autonomy, and seeking feedback behaviors. It is recommended that the student's mindset be considered and that a focus on investing in AI skills in teaching be made to develop student engagement and academic success in the environment.

Faculty Training and Professional Development There is a need to play a significant role in meeting the successful integration of GAI with faculty readiness and digital competencies through professional development (Eager and Brunton, 2023; Kohnke, Moorhouse, and Zou, 2023). Promoting professional development initiatives designed to enhance teaching effectiveness, build confidence, and ensure secure ethical AI-based practices. All integration attempts must be guided by institutional values and pedagogical considerations to harness GAI's benefits in higher education fully.

In conclusion, the literature on the impact of GAI within higher education describes a dynamic field of promise, challenges, and ongoing research activities. While GAI offers great promise to transform teaching and learning experiences by addressing ethical concerns, promoting student engagement, and supporting faculty development, responsible integration in higher education settings is essential. Further research is needed to explore the many implications of GAI entirely for future inquiries in this evolving field.

3. Methodology

This article is based on a sample of 77 individuals who are teachers and/or researchers in higher education. The information was collected online through a questionnaire with the title "Characterizing the use of generative artificial intelligence applications in higher education in Portugal", from April 1, 2023, to June 30, 2023. With this sample we wanted to find out which IAG applications are most used in the teaching-learning process and for what purpose, how often they are used to carry out a series of tasks and the perception of control in the use of IAG. To answer these questions, the data collected was processed using IBM SPSS Statistics 29.0. The statistical analyses used was reliability analysis (Cronbach's alpha), descriptive measures (mean, standard deviation) and graphical representations (bar and boxplot), Spearman correlation coefficient, nonparametric Chi-square independence test, Kruskal-Wallis test with Dunn's test for multiple comparisons and Mann-Whitney test.

4. Results and Discussion

Of the 77 participants included in this study, 59.7% were male, while 40.3% were female. Participant's age varied significantly, covering a wide range, from 25 to 89 years, with an average age of 51.56 years. As for educational level, the majority of participants, 83.1%, have a PhD, 14.3% a Master's degree, while only 2.6% have a bachelor's degree. Further analysis revealed the diversity of the participants' educational backgrounds. Around 16.9% of the individuals have a degree in the exact and natural sciences and 28.6% in engineering and technology. The social sciences represent a substantial proportion of the sample, with 35.1% of participants identified as belonging to this area. In addition, 10.4% of participants have a background in the humanities. The remaining participants are distributed among other unspecified areas.

Figure 1 shows the percentage of use, in the teaching-learning process, of each of the tools indicated in the questionnaire. The most used tool is ChatGPT (70% of participants) followed by QuilBot (21%), ChatPDF (14%) and BingChat (12%). It should also be noted that 16% of the participants in the study also use other GAI tools not indicated in the questionnaire.

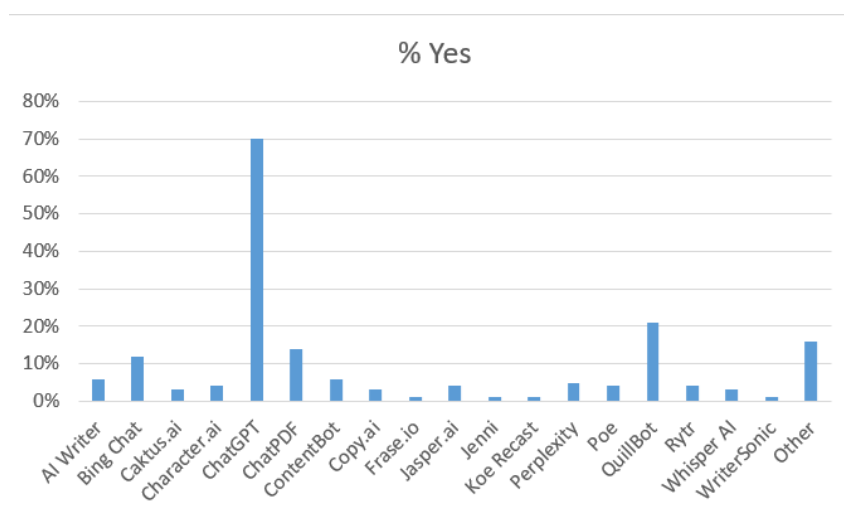


Figure 1: Bar for tasks in which GAI is used in the teaching-learning process.

Regarding the objectives for generative AI applications, Table 1 shows the percentages of use/non-use of these tools for carrying out nine tasks. The results obtained show that most participants use the GAI tools for “Idea generation” (67.5%) and “Explaining concepts” (54.5%), with 45.5% of participants use for “Brainstorming”, 40.3% for “Find sources”, 33.8% for “Resource generation”, 37.7% for Proofreading, with lower (although higher than 15%) usage percentages for “Feedback and evaluation”, “Generating presentations” and “Citing and formatting”.

Table 1: Frequencies of the use/non-use of some tasks

	Explaining concepts (can simplify complex concepts)		Resource generation (can create flash cards, review activities, analytical tools)		Idea generation (can simulate creative thinking and ideas as a starting point)		Feedback and evaluation (can provide instant feedback on work to improve quality before submission)		Brainstorming (create ideas or work topics to provide different suggestions or perspectives)		Proofreading (create activities to aid better understanding)		Generating presentations (can provide suggestions for improving presentations)		Citing and formatting (can provide references and advice for citing throughout the text)		Find sources (can be used to find sources to help with research. Similar to using Wikipedia or Google)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
%	45,5%	54,5%	66,2%	33,8%	32,5%	67,5%	83,1%	16,9%	54,5%	45,5%	62,3%	37,7%	80,5%	19,5%	84,4%	15,6%	59,7%	40,3%

Regarding the degree of agreement (5-point Likert scale from 1- Strongly disagree to 5- Strongly agree) with four statements on academic ethics and intellectual integrity, Table 2 shows some descriptive measures (mean, standard deviation, and quartiles). Cronbach's alpha reliability analysis was used to verify whether the variability of each dimension's items (answers to the questions) effectively resulted from differences in participants' opinions. In this case we obtained a value of 0.915 which is considered excellent reliability.

Table 2: Descriptive measures for questions about academic ethics and intellectual integrity

Statistics				
	Creating content without proper citation, which is unethical and plagiarized	Creating essays or projects without any personal input, which is detrimental to the learning process.	Completing tasks that are beyond their knowledge and understanding and presenting the results as their own, which is considered academic dishonesty	Asking for bibliographical references and not checking their validity and relevance, which is inappropriate.
Mean	4,10	4,09	4,22	4,31
Std. Deviation	1,187	1,248	1,154	1,042

Consulting the table allows us to conclude that the majority of participants totally agree with the statements "Creating content without proper citation is unethical and plagiarized", "Creating essays or projects without any personal input is detrimental to the learning process", "Completing tasks that are beyond their knowledge and understanding and presenting the results as their own is considered academic dishonesty" and "Asking for bibliographical references and not checking their validity and relevance is inappropriate", with the variability of responses being considered low.

Additionally, we can state that at least 75% of respondents concur with these four assertions. However, analyzing the answers to each statement further, we see that 15.6% of the participants disagree or totally disagree with the question "Creating content without proper citation is unethical and plagiarized," 13% with the question "Creating essays or projects without any personal input is detrimental to the learning process," 9.1% with the question "Completing tasks that are beyond their knowledge and understanding and presenting the results as their own is considered academic dishonesty," and 7.8% with the statement "Asking for bibliographical references and not checking their validity and relevance is inappropriate."

To assess the degree of frequency (in a 5-Likert scale from 1 – Never to 5 - Always) with which the participants use generative AI to carry out a set of tasks, a boxplot is constructed (Figure 2). The value of Cronbach's alpha (0.893), which is considered very good, shows the consistency of items.

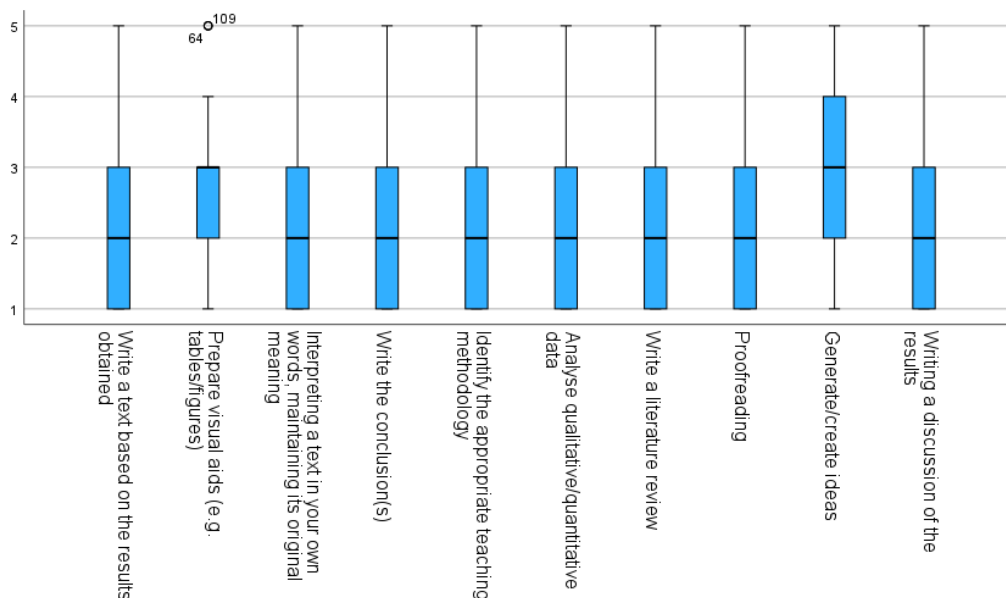


Figure 2: Boxplot for tasks in which GAI is used in the teaching-learning process.

The information resulting from Figure 2 alongside the descriptive measures obtained for these tasks (Table 3) allowed us to conclude that the most frequently used task is "Generate/create ideas," followed by "Prepare visual aids," although they are only used sometimes. All other tasks are mostly marked as "almost never". Also noteworthy in Figure 2 is the occurrence of 3 outliers (participants 64, 9 and 10), who said that they always use GAI to prepare visual aids.

Table 3: Descriptive measures for tasks in which GAI is used in the teaching-learning process.

Statistics										
	Write a text based on the results obtained	Prepare visual aids (e.g. tables / figures)	Interpreting a text in your own words, maintaining its original meaning	Write the conclusion(s)	Identify the appropriate teaching methodology	Analyze qualitative / quantitative data	Write a literature review	Proofreading	Generate / create ideas	Writing a discussion of the results
Mean	2,42	2,57	2,45	2,18	2,43	2,10	2,12	2,53	3,05	2,04
Std. Deviation	1,207	1,186	1,176	1,109	1,163	1,273	1,158	1,304	1,234	1,094

Crossing now the information about the degree to which the participants use generative AI to carry out a set of tasks with objectives for using generative AI applications we obtained Spearman's correlation coefficients (given the ordinal nature of the questions-variables). The results show that there is a strong positive correlation (when the degree of agreement in one variable increases, the other variable tends to increase as well) between the following variables:

- "Write a text based on the results obtained" versus
- "Prepare visual aids" ($r_s=0.647$)
- "Interpreting a text in your own words, maintaining its original meaning" ($r_s=0.649$)
- "Write the conclusion(s)" ($r_s=0.674$)
- "Analyze qualitative/quantitative data" ($r_s=0.666$)
- "Writing a discussion of the results" ($r_s=0.688$)
- "Write the conclusion(s)" versus "Interpreting a text in your own words, maintaining its original meaning" ($r_s=0.748$)
- "Analyze qualitative/quantitative data" versus
- - "Interpreting a text in your own words, maintaining its original meaning" ($r_s=0.615$)
- - "Write the conclusion(s)" ($r_s=0.674$)
- "Writing a discussion of the results" versus
- "Write the conclusion(s)" ($r_s=0.693$)
- "Interpreting a text in your own words, maintaining its original meaning" ($r_s=0.677$)

After conducting an exploratory analysis, we want to verify if there are significant differences between some variables according to gender, age or teaching in University/Polytechnic higher education or researcher. To achieve this, we perform Kolmogorov-Smirnov test to determine the normality of some variables. As the hypothesis was rejected, we used non-parametric tests, specifically the Kruskal-Wallis and Wilcoxon-Mann-Whitney tests.

To assess whether there are significant differences between "Explaining concepts" as an objective to use GAI according to Professors (universities, polytechnic) or researchers (two nominal variables) we used Chi-Square test (Tables 4 and 5). The results allow us to conclude that with a significance level of 8%, there are some differences, namely, while most professors (59.2% from university professors and 62.5% from polytechnics professors) use the GAI to explain concepts, most researchers do not (25%). There were only one significant difference between gender and the objective "Brainstorming" for using the GAI (p -value=0.05); the majority of male use GAI with this objective (71.4%) and the majority of female no.

The use of the Kruskal-Wallis test revealed significant differences at the 5% level regarding the frequency of "Prepare visual aids" concerning the variable "Teaching in University/Polytechnic higher education or researcher" (p -value=0.044). A more in-depth analysis using Dunn's test for multiple comparisons concluded that what causes this difference are the answers given by university professors when compared to researchers (p -value=0.012), which is not surprising given that we are assessing the performance of these tasks only in the context of the teaching-learning process. Professors prepare visual aids more often, as would be expected.

Table 4: Contingency table

Explaining concepts (can simplify complex concepts) * Education/Researcher Crosstabulation						
			Education/Researcher			Total
			University education	Polytechnic education	Researcher	
Explaining concepts (can simplify complex concepts)	No	Count	20	6	9	35
		% within Explaining concepts (can simplify complex concepts)	57,1%	17,1%	25,7%	100,0%
		% within Education/Researcher	40,8%	37,5%	75,0%	45,5%
	Yes	Count	29	10	3	42
		% within Explaining concepts (can simplify complex concepts)	69,0%	23,8%	7,1%	100,0%
		% within Education/Researcher	59,2%	62,5%	25,0%	54,5%
Total	Count	49	16	12	77	
	% within Explaining concepts (can simplify complex concepts)	63,6%	20,8%	15,6%	100,0%	
	% within Education/Researcher	100,0%	100,0%	100,0%	100,0%	

Table 5: Results of independence Chi-Square test.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,059 ^a	2	,080
Likelihood Ratio	5,175	2	,075
Linear-by-Linear Association	3,118	1	,077
N of Valid Cases	77		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5,45.

Finally, using the Mann-Whitney test, significant differences are detected (at a significance level of 5 percent) in the degree of frequency with which the GAI tools are used to carry out certain tasks according to gender (Table 6). In particular, "Write a text based on the results obtained" (p-value = 0.003), "Prepare visual aids" (p-value = 0.0439), "Interpreting a text" (p-value = 0.031), "Write a literature review" (p-value = 0.007), "Generate/create ideas" (p-value = 0.009), and "Write a discussion of the results" (p-value = 0.019). In all cases, men use GAI more often to carry out these tasks. For example, for "Write a text based on the results obtained," 41.9% of female never do it, while only 23.9% of male never do it.

Table 6: Results of Mann-Whitney test for degree of frequency of use of GAI to carry some tasks.

Test Statistics ^a										
	Write a text based on the results obtained	Prepare visual aids (e.g. tables / figures)	Interpreting a text in your own words, maintaining its original meaning	Write the conclusion(s)	Identify the appropriate teaching methodology	Analyze qualitative / quantitative data	Write a literature review	Proofreading	Generate / create ideas	Writing a discussion of the results
Mann-Whitney U	434,500	524,000	511,500	549,000	665,500	598,500	467,000	574,000	468,500	499,000
Wilcoxon W	930,500	1020,000	1007,500	1045,000	1161,500	1094,500	963,000	1070,000	964,500	995,000
Z	-3,000	-2,023	-2,161	-1,775	-,509	-1,261	-2,681	-1,487	-2,621	-2,344
Asymp. Sig. (2-tailed)	,003	,043	,031	,076	,610	,207	,007	,137	,009	,019

a. Grouping Variable: Gender

Finally, when it comes to the participants' perception of the use of GAI, this is identical for all five questions (in a 5-point Likert scale from 1 to 5, strongly disagree to 5 to strongly agree), as can be seen in Table 7. The median for all 5 questions is 4, which means that at least 50% of the participants agree that they have the resources, time, and opportunities to use GAI while doing their job, are confident that they can use GAI to do their job, would recommend the use of GAI to others, and agree that the use of GAI depends only on themselves. The latter, however, is the one with the lowest level of agreement; 27.3% of participants disagree or strongly disagree.

Table 7: Descriptive measures for perceptions.

Statistics						
		The use of generative AI only depends on me	I have the resources, time, and opportunities to use generative AI while doing my job	I am confident that I can use generative AI to do my job	It is beneficial to use generative AI while doing my job	I would recommend using generative AI to others
Mean		3,38	3,51	3,45	3,71	3,74
Percentiles	25	2,00	3,00	3,00	3,00	3,00
	50	4,00	4,00	4,00	4,00	4,00
	75	4,00	4,00	4,00	4,00	4,00

The questionnaire also included an open question, "What impact do, or can generative AI applications have on the teaching-learning process?" and there was a wide range of perspectives. Some people consider that generative AI can simplify time-consuming tasks in a short period of time, facilitate the generation of scenarios and content to support learning, and serve as an assistant in the work of preparing teaching activities and interacting with students to enable self-study. However, there are concerns that generative AI could block creativity, increase the risk of false conclusions or misleading learning, and even complicate the teaching-learning process. Some believe that the impact of generative AI can be both positive and negative, depending on how it is used, and emphasize the importance of incorporating AI responsibly into educational work. There is also an emphasis on the need for critical analysis and care when using generative AI as a tool to support teaching. In addition, there is mention of the need to consider ethical issues associated with the introduction of AI tools in the academic context, such as privacy, data security, and proper governance. Training and sensitization of professors on the ethical use of AI are also highlighted as important.

Overall, it seems that there is a growing awareness of both the positive and negative potential of generative AI in higher education, and there is a recognition of the need for a cautious and informed approach when integrating this technology into the educational environment.

5. Conclusions and Future Work

The study presented in this article shows the transformative potential of GAI in the panorama of higher education in Portugal. As evidenced through comprehensive surveys and statistical analyses, GAI applications are increasingly integrated into educational environments, providing substantial benefits such as personalized learning experiences and interactive teaching methodologies. Thus, based on the results obtained, these tools improve the teaching process and actively involve students, promoting a more interactive and responsive learning environment. However, the integration of this technology raises ethical concerns, such as data privacy, the integrity of academic results, and the potential for bias in AI-generated content. These issues require regulatory measures on the part of higher education institutions to take advantage of GAI's benefits and mitigate its risks.

According to the study carried out regarding the implementation of Artificial Intelligence Generating tools in the teaching-learning process, the GAI tool most used by the participants is ChatGPT. Regarding the objectives for generative AI applications, the results obtained show that most participants use the GAI tools for "Idea generation" (67.5%) and "Explaining concepts" (54.5%). The majority of participants totally agree with the questions about academic ethics and intellectual integrity. Moreover, the most frequently applied tasks in which GAI is used are "Generate/create ideas," followed by "Prepare visual aids," although they are only used sometimes. Crossing the information about the degree to which the participants use generative AI to carry out a set of tasks with objectives for using generative AI applications we found some strong positive correlations. We also concluded that there are significant differences between gender and the objective "Brainstorming" for using the GAI; the majority of male use GAI with this objective (71.4%). Within the tasks where GAI is used, with

relevance, in the teaching-learning process, it was found that regarding the frequency of 'prepare visual aids', there are significant differences depending on whether the participant is a professor or a researcher – professors tend to use more. Finally, we detected significant differences in the degree of frequency with which the GAI tools are used to carry out certain tasks according to gender (men use GAI more often to carry out these tasks).

Some people consider that generative AI can simplify time-consuming tasks in a short period of time, facilitate the generation of scenarios and content to support learning, and serve as an assistant in the work of preparing teaching activities and interacting with students to enable self-study. There is also an emphasis on the need for critical analysis and care when using generative AI as a tool to support teaching. In addition, there is mention of the need to consider ethical issues associated with the introduction of AI tools in the academic context, such as privacy, data security, and proper governance. Training and sensitization of professors on the ethical use of AI are also highlighted as important.

As future work, several areas require further exploration to understand better and optimize the use of GAI in education: Longitudinal Studies to assess the long-term impacts of GAI on educational outcomes and student engagement. This will help us understand the sustained effects of integrating AI into learning environments. Expand research to include diverse educational settings and demographic groups to determine the varying impacts of GAI in different contexts. Implement targeted professional development programs to equip educators with the skills and knowledge necessary to use GAI tools effectively. This includes training in ethical considerations and technical proficiency. To summarize, although the GAI presents significant opportunities to revolutionize the education sector, carefully analyzing its challenges and potential pitfalls is essential. By addressing these concerns and focusing on sustainable development, the GAI can significantly contribute to the evolution of higher education, making learning more accessible, personalized, and efficient.

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