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Innovation in higher education: from teaching practices during the pandemic to generative artificial intelligence

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Inovação na educação superior: das práticas pedagógicas do período pandêmico à inteligência artificial generativa

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Innovación en la educación superior: de las prácticas pedagógicas pandémicas a la inteligencia artificial generativa

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Abstract: *This study examined the relationship between innovative pedagogical practices adopted during the pandemic and the subsequent adoption of Generative Artificial Intelligence (GAI) in higher education. Data were collected through interviews and questionnaires administered to university teachers in Santa Catarina. Qualitative analysis, based on Bardin's (2016) techniques, revealed the following: First, for the teachers investigated, pedagogical innovation is linked to reframing methodologies, promoting student protagonism, integrating theory and practice, and using new technologies. Second, during the pandemic, innovation focused on technology-mediated classes. Third, remote teaching accelerated the adoption of GAI, broadening teachers' perceptions of flexible and intelligent tools. However, concerns also arose regarding the regulation of GAI, the risk of digital exclusion, the precarious nature of teaching work, and the lack of comprehensive student training.*

Keywords: *Artificial intelligence. Higher education. Innovation. Pedagogical experiences.*

Resumo: Esta pesquisa buscou compreender a relação entre as práticas pedagógicas inovadoras adotadas durante a pandemia de Covid-19 e sua influência na adoção da Inteligência Artificial Generativa (IAG) na Educação Superior no período pós-pandêmico. Os dados foram coletados por meio de entrevistas e questionários aplicados a professores de uma universidade catarinense. A análise qualitativa, baseada nas técnicas de Bardin (2016), revelou que: 1) para os docentes investigados, a inovação pedagógica está ligada à ressignificação de metodologias, ao protagonismo estudantil, à integração teoria-prática e ao uso de novas tecnologias; 2) na pandemia, a inovação centrou-se em aulas mediadas por tecnologia; 3) o ensino remoto acelerou a adoção da IAG, ampliando a percepção docente a respeito das ferramentas flexíveis e inteligentes. Também surgiram preocupações em relação à regulação da IAG, riscos de exclusão digital, precarização do trabalho docente e distanciamento da formação integral do estudante.

Palavras-chave: Educação superior. Experiências pedagógicas. Inovação. Inteligência rtificial.

Resumen: *Esta investigación buscó comprender la relación entre las prácticas pedagógicas innovadoras adoptadas durante la pandemia de COVID-19 y su influencia en la adopción de la Inteligencia Artificial Generativa (IAG) en la Educación Superior en el período pospandémico. Los datos se recopilaron mediante entrevistas y cuestionarios administrados a profesores de una universidad de Santa Catarina. El análisis cualitativo, basado en las técnicas de Bardin (2016), reveló que: 1) para los profesores estudiados, la innovación pedagógica está vinculada a la redefinición de metodologías, el empoderamiento estudiantil, la integración teoría-práctica y el uso de nuevas tecnologías; 2) durante la pandemia, la innovación se centró en*

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clases mediadas por tecnología; 3) el aprendizaje remoto aceleró la adopción de la IAG, ampliando las percepciones de los profesores sobre herramientas flexibles e inteligentes. También surgieron preocupaciones con respecto a la regulación de la IAG, los riesgos de exclusión digital, la precariedad de la enseñanza y la desconexión del desarrollo integral del estudiante.

Palabras clave: *Educación superior. Experiencias pedagógicas. Innovación. Inteligencia artificial.*

1 INTRODUCTION

In contemporary society, social, cultural, and economic transformations are constant, especially due to advances in science and technology. The impact of the Covid-19 pandemic in Brazil began with the declaration of a national emergency on February 3, 2020 (Brazil, 2020), and officially ended on April 22, 2022, with the issuance of Ordinance GM/MS No. 913 (Brazil, 2022). This pandemic accelerated debates about innovation in various areas, including education. The health crisis that led to social isolation consequently determined the adoption of new technology-mediated teaching models. As educational technologies became essential for maintaining formal teaching activities, developing new strategies to promote student engagement in the learning process became a priority for higher education institutions (HEIs).

However, now that the pandemic is over, a new discussion has emerged regarding the use of technology in higher education: the use of generative artificial intelligence (GAI) in educational processes. The guiding problem of this research emerged from the interrelationship between teaching mediated by digital technologies during the pandemic and the spread of GAI in the post-pandemic period: Did the use of innovative pedagogical practices mediated by digital technologies during the pandemic influence the adoption of GAI in higher education in the post-pandemic period?

Based on this question, we outlined the research's general objective: to understand the relationship between the innovative teaching practices adopted during the pandemic and their influence on the adoption of Generative Artificial Intelligence (GAI) in higher education after the pandemic. To this end, we established two specific objectives: 1) to identify teachers' perceptions of innovation and the innovative pedagogical practices they adopted during the pandemic, and 2) to analyze how these practices may have influenced the adoption of GAI in higher education after the pandemic.

2 REFERENTIAL

Although many digital tools existed before the pandemic, they were largely overlooked in many classrooms. The challenging period that began with the pandemic brought many new experiences and lessons. Web conferencing platforms such as Google Meet, Zoom, and Teams, as well as digital content management systems, ensured the synchronous presence of teachers and students in remote classes. These tools enabled reflection and the implementation of new practices in higher education. However, we start from the theoretical premise that the mere use of different methodological tools does not determine innovation in education. This research analyzes the phenomenon of innovation in educational contexts, primarily based on the theoretical contributions of Cunha et al. (2006), Cunha and Wolff (2006), Cunha (2016), Volpato (2010), Wiebusch and Lima (2018), Masetto (2004), and Nóvoa and Alvim (2021). We address issues related to the phenomenon of GAI, considering recent studies by Banh and Strobel (2023), Adiguzel, Kaya, and Cansu (2023), Costa et al. (2025), Bottentuit Junior et al. (2024), and Faustino, Constantino, and Gonçalves (2025).

We emphasize that "what differentiates innovative teaching from traditional practices are teachers' attitudes and behaviors towards knowledge; teachers do not consider it to be ready or finished" (Volpato, 2010, p. 138). Therefore, viewing innovation solely as the incorporation of digital and technological devices in educational institutions is reductionist, though it cannot be denied that technology is intertwined with innovation and can ensure its effectiveness.

According to Cunha (2016), innovation is the product of people's actions and requires a new understanding of knowledge. This presupposes a change in the epistemological foundations of pedagogical practice, which is not always achieved by merely using technological resources in teaching and learning processes. Thus, this text discusses in depth the innovation based on pedagogical practices during the pandemic and its relation to the dissemination of GAI in higher education. It problematizes the perspective of teacher training and the role of teachers in the face of new technological solutions.

3 METHODOLOGICAL PROCEDURES

This study, conducted by the University Study Group (GEU) at the University of the Far South of Santa Catarina (Unesc) and accredited by the Central Directory of Research Groups of the National Council for Scientific and Technological Development (CNPQ), takes a qualitative approach.

Data collection took place at Unesc, a non-profit community university founded 57 years ago in Santa Catarina with more than 17,000 students (Unesc, 2024). During the pandemic, Unesc reinvented itself and used its experience to protect people, maintain the quality of education, and contribute to society. Additionally, Unesc "put all its technological and innovative capacity into practice so that students would not be harmed by the suspension of face-to-face classes" (Unesc, 2025). Unesc's efforts to combat the pandemic were recognized by the Legislative Assembly of Santa Catarina (Alesc) in 2020. The university officially received congratulations from the legislative house, which highlighted the importance of the community university's actions during the health emergency (Unesc, 2020). In the following year, 2021, Unesc received further recognition among non-profit organizations when it was certified by Alesc for its actions related to the pandemic (Santa Catarina, 2021).

Considering the university's commitment to its educational and social mission, it proved to be a suitable location for the research, which was conducted in two stages. The first stage took place in 2021 and consisted of 12 semi-structured interviews with teachers from various fields. The second stage took place in 2025 and involved administering questionnaires with open-ended questions to ten of the teachers who were interviewed in the first stage. The research subjects were selected to ensure a diverse group of participants. They were professors from undergraduate courses in law, education, administration, physical education, nursing, pharmacy, mathematics, biomedicine, surveying engineering, physics, and materials engineering. In terms of highest academic qualification, one teacher has only completed a specialized course, eight have master's degrees, and three have doctorates. The research subjects' teaching experience ranged from six to 22 years, and this article uses letters and numbers to ensure anonymity.

We used content analysis based on Bardin's (2016) procedures to interpret the data and identify thematic patterns in the research participants' discourse that allowed for the development of a categorical analysis.

4 RESULTS AND DISCUSSION

4.1 INNOVATION IN HIGHER EDUCATION: BETWEEN THE CONCEPT AND TEACHING PRACTICES DURING THE PANDEMIC PERIOD

We asked our interviewees about their understanding of innovation in higher education. Following Bardin's (2016) procedures, we developed qualifying themes based on the interviewees' discourse and grouped them into categories for analysis. Most interviewees (11 of them) understood innovation as reframing pedagogical methodologies and practices**.** They related this concept to the ability to constantly reinvent oneself to keep up with cultural and social changes in society, especially in professional practices in the world of work. According to Cunha and Wolff (2006, p. 41), "Innovation exists in a particular place, time, and circumstance as a product of people's actions on the environment or social milieu." This concept was explicitly addressed in the

responses of eleven interviewees, with the following remarks being particularly noteworthy: *"I consider innovation to be the ability to reinvent oneself" (E08) and "Observe the scenario and see what strategies I am going to change"* (E06). In this context, Forster et al. (2006, p. 50) emphasize:

> *Innovation is identified with changes in teaching methods, including the complementation of methods and processes. There is a movement beyond simply doing things differently, introducing new ways of working, seeking, above all, to move beyond sameness and meaningless activities.*

In the second category of analysis, which refers to ensuring students play a leading role in the learning process; we find the innovation indicator identified by five interviewees. This perspective aligns with an innovation indicator adopted by Cunha et al. (2006, p. 64), who define protagonism as "*student participation in pedagogical decisions, valuing students' personal, original, and creative production, and stimulating more complex, non-repetitive intellectual processes.*" The interviewees reported that innovating means providing academics with the necessary tools and methodologies to encourage student participation and "*place students as the protagonists of the teaching and learning process. Students need to learn to act, reflect, analyze, make connections, and propose solutions"* (E04). Interviewee E05 also stated that innovation promotes student protagonism and aims to encourage the appropriation of systematized knowledge in a dynamic, critical, participatory, and democratic manner. Furthermore, E03 and E04 mentioned seeing innovation as breaking with the traditional model and moving from a transmissive perspective to a participatory one, where interaction occurs between teacher and student. Additionally, three interviewees stated that innovation involves encouraging listening, speaking, and research to promote good communication and interaction with students.

The third category of analysis is based on the perception of four teachers for whom innovation means relating theory and practice so students can relate the classroom content to their daily lives. This idea is evident in the following statement by interviewee E03: "*If I only receive data, then I only have information, which is easily forgotten. However, knowledge is retained, so associating theory and practice is where I find innovation*." In this category, theoretical knowledge associated with practice is therefore a form of innovation. This concept is supported by Cunha et al.'s (2006, p. 67) study, which states "*social practice is a condition for the problematization of the knowledge that students need to produce*." Thus, reorganizing the relationship between theory and practice in a disruptive way translates into paradigmatic innovation that can exist in different times, spaces, and environments, including virtual ones. As Wiebusch and Lima (2018, p. 157) point out:

In this regard, classes should be more dynamic, contextualized, interdisciplinary, thematic, dialogical, and challenging. This will allow students to build knowledge, gain real experience, and establish stronger connections between the university, the job market, and their future professions. Ultimately, this will ensure meaningful learning in higher education. Classrooms are where students ask questions, construct arguments, express ideas, and clarify doubts because university classes should be interactive and formative environments.

Finally, the fourth category of analysis refers to the perspectives of three interviewed teachers who pointed out that innovation in higher education involves using technological **resources.** This is evident in the following statement: *"For me, innovation in higher education involves handling technological resources"* (E02). However, we reiterate that technological resources can only be considered innovative when they are associated with *"a new understanding of knowledge and, consequently, a change in the epistemological foundations of pedagogical practice"* (Cunha, 2016, p. 94). It is worth clarifying that, when discussing innovation during the pandemic, the interviewees expressed this perspective in relation to the use of technological resources. This indicates that they understand the use of

technologies constitutes innovation in higher education only when it promotes a break with traditional teaching and learning methods.

We also sought to identify the innovative pedagogical practices that the interviewees considered to be effective during the pandemic, since numerous changes had to occur for teaching activities to continue during the global health emergency. Using the same procedure described above, we created categories of analysis based on the recurring themes in the participants' responses.

All interviewees believe that innovation during the pandemic was related to classes mediated by technological resources, which was the first category of analysis. In this regard, interviewee E06 reported: "The programs used during the pandemic were innovative for teachers who did not have much contact with these technologies." However, we reiterate that the inclusion of technologies in teaching, to be considered innovation, cannot be an end in itself. Forster et al. (2006, p. 48) report that it is necessary to break with the dominant methodological and epistemological process for technologies to be considered a means of disruption.

In this perspective, four interviewees expressly mentioned that the use of different technological tools was carried out with the aim of achieving effective student participation, as follows:

> *I am going to use innovation to get my students to be in class instead of playing video games, watching soap operas, or having dinner with their families. In other words, innovation is finding a method that keeps students in class (E03).*

It is important to note that introducing these technological resources into the academic environment during the pandemic had advantages and disadvantages. Several teachers reported problems they encountered, including difficulties with interaction between academics, as well as between teachers and students. Two teachers noted that effective interaction via Google Meet was innovative. Based on the interviewees' reports, the difficulties students faced when participating in classes were clear. Few students turned on their cameras and microphones to talk to the teacher and their classmates.

Conversely, recording classes and making them available to students was considered innovative since this possibility had not been considered for in-person teaching before. Teachers reported that technology allowed students to attend classes at different times and in different spaces via cell phones, tablets, or notebooks. This assessment aligns with Volpato's (2010, p. 133) perspective that the use of new technologies can be innovative if it promotes dynamic and interactive teaching and learning methods.

Beyond the discourse related to the possibilities for innovation through classes mediated by technological resources, a second category of analysis emerged: the use of technological resources to enable scientific meetings with academic authorities who would not be able to participate in a face-to-face model.

During the pandemic, it became clear that this possibility emerged strongly in higher education institutions (HEIs), where guests from different fields and all over the world could gather on the same virtual platform to give lectures and promote discussions on various topics. Interviewee E05 mentioned this innovative factor as being "a differential, as this flexibility for meetings enabled greater accessibility for students, teachers, and guests."

Now that the pandemic is over, it is clear that this practice has been incorporated into higher education institutions. It has become commonplace for scientific authorities to be present remotely at university events, such as conferences, seminars, and dissertation and thesis defense panels. Woicolesco, Morosini, and Marcelino (2022) state that the pandemic allowed Information and Communication Technologies (ICTs) to be incorporated into internationalization efforts, enabling researchers and students to meet people from different cultures within the campus itself and promoting internationalization at home.

Finally, a third category of analysis includes the renewal of assessment processes as an in-

novative pedagogical practice during the pandemic. This concept is highlighted in the following statement by interviewee E11: *"The renewal of methodological assessment processes accelerated things significantly. Teachers had to reinvent themselves, especially the way they assessed students."*

The process of monitoring teaching and learning to achieve appropriate objectives, content, and methodologies—involving qualitative and quantitative aspects—underwent changes during the pandemic. Students carried out assessment activities remotely and could consult websites and bibliographic materials. They could also interact with their peers via WhatsApp and social networks. In this scenario, a sense of strangeness was evident among those involved in the teaching-learning process. Bortolin and Nauroski (2022) conducted a study based on scientific articles published between 2020 and 2022 on the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (Capes) to understand the challenges of learning assessment in the context of the pandemic. The authors showed that most teachers qualitatively changed the way they assessed, making it very different from what they practiced in face-to-face teaching. From this study, we highlight:

There was a need for research by students, seminars, and a reduction in the number of objective tests. However, some teachers reported discomfort with conducting online tests since students could "cheat" on the internet. This data makes us rethink the function of assessment and its negative perception by teachers (Bortolin; Nauroski, 2022, p. 17-18).

The authors also mentioned that a lack of teacher preparation in ICT use was one of the challenging factors in the compulsory adaptation of assessments to remote teaching models. Many tools related to new digital technologies had been available for some time before the pandemic, but they were underused or not used at all in teaching practices. Due to the need for adaptation imposed by the health emergency, many higher education institutions (HEIs) sought to equip teachers to use these tools.

Beyond the assessment context, the interviewees cited difficulties and obstacles they encountered at the beginning of remote classes. They said that they had to adapt their practices to the available technology so that students could effectively participate in classes. They also mentioned the difficulty or impossibility of carrying out practices that were innovative in face-to-face teaching, such as study trips and laboratory practicals. They complained about the lack of student participation and uncertainty about their actual presence in meetings since many students did not turn on their cameras during virtual meetings. They also reported difficulties in assessing learning and a significant increase in workload due to the new processes for responding to student needs.

In this sense, Volpato (2010, p. 55) pointed out that change processes require overcoming organizational, administrative, economic, and psychosocial obstacles in institutions. This appears to have been the case because, despite the reported adversities, the teachers stated that they adapted to the tools and the new teaching model over time.

This corroborates the position of the HEI under investigation, which, according to the interviewees, offered mini-courses, lectures, and roundtables to help teachers understand and adopt the new tools in an innovative context. Considering this, it is worth noting that the university's movement was toward understanding innovation as a collective activity and not just as an individual effort. According to Wiebusch and Lima (2018, p. 159), "An innovation will be successful if there is university management planning, infrastructure changes, changes in teaching, teacher training, innovative pedagogical practices, and student participation."

Five of the interviewees indicated that the university provided training workshops on pedagogical tools and discussions on active and innovative methodologies during the pandemic. Two of the twelve teachers interviewed mentioned that the topic of innovation was present in the discussions held by teachers

during the pedagogical week at the HEI. In this context, Masetto (2004, p. 198) emphasizes the importance of

[...] preparing teachers to commit to innovation and take on innovative projects through continuous in-service teacher training that enables reflection on their teaching activities, the exchange of experiences with colleagues, and dialogue between different areas.

Teachers reported greater interaction with students and significant improvement in communication when using technology for innovative teaching and learning practices instead of virtually reproducing lecture-style classes designed for face-to-face instruction. Through these new practices, students learned to work better as a team and think for themselves about solutions to the presented problems. Teacher E08 reported that many students approached him to join his research group to continue interacting, learning, and advancing in their studies. Masetto (2004, p. 198) corroborates this idea, affirming the importance of replacing the teacher's role as lecturer and transmitter of information with that of pedagogical mediator. This involves developing a relationship of partnership and co-responsibility with students and working as a team.

In short, the interviewees cited the Covid-19 pandemic as a factor that accelerated innovation in technology and pedagogy. To some extent, the process of pedagogical innovation was already underway at the HEI investigated. However, three central aspects of pedagogical practices during the pandemic emerged: some innovative face-to-face teaching practices, such as internships, study trips, and laboratory activities, could no longer be carried out; other activities had to be adapted to the new situation; and new practices emerged that were only possible because of the pandemic, leading teachers to use technological resources in their classes.

However, once the pandemic is over, a new challenge will emerge in higher education: the adoption of GAI and its impact on teaching processes. We will address this topic in the following subsection.

4.2 GENERATIVE ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: A BOOST FROM THE PANDEMIC?

Artificial intelligence (AI) is a broad term involving various computational algorithms that perform tasks requiring human intelligence. The term is not new; Costa (2007) states that it originated in speculative essays about computers written by Turing in 1950. However, the author also reports that the term as we know it today originated in 1956 from a meeting of ten scientists at Dartmouth College in New Hampshire.

According to Banh and Strobel (2023), the first AI systems were created to support users and companies in decision-making processes. Driven by technological advances, these authors state that AGI (artificial general intelligence) emerged. AGI can be trained to generate new information and interact with users through prompts. This interaction technique allows end users to interact with applications and produce new content, such as texts, images, and videos, using natural language. In education, according to Bates (2017, p. 242):

Attempts to replicate the teaching process through artificial intelligence (AI) began in the mid-1980s, initially focusing on teaching arithmetic. Despite major research investments in AI for education over the past 30 years, results have generally been disappointing. It has proven difficult for machines to cope with the extraordinary variety of ways in which students learn (or fail to learn).

However, recent scientific publications highlight the increasing presence of AI in universities, particularly following the release of ChatGPT in 2022. According to Adiguzel, Kaya, and Cansu (2023), AI has ushered in a new era of innovation and transformation in many areas, including education. The authors note that intelligent tutoring systems, automated assessment systems, and personalized learning platforms are just a few examples of educational applications that already use AI. Such tools were widely used during the pandemic, and according to teachers interviewed in this study, they have truly become an innovation in

higher education. However, the authors point out that advanced AI systems, such as chatbots and ChatGPT, offer potential benefits to education, yet their use requires much ethical and practical discussion. They note that these programs can improve students' academic performance and enable teachers to provide more personalized instruction. They argue that it is possible to provide personalized feedback and assistance, as well as adapt classes to students' needs, thereby increasing engagement and motivation.

In the second stage of this research, we invited the teachers interviewed in 2021 to answer the following question: In your opinion, did remote teaching adopted during the pandemic influence the adoption of generative artificial intelligence in higher education? How and why?"

Eight of the ten respondents, all of whom were teachers, stated that remote teaching adopted during the pandemic influenced the adoption of GAI in higher education. Two teachers responded that it did not. Analyzing the motivations behind these responses allowed us to categorize the interviewees' perceptions, which we will discuss below.

Five of the teachers who responded positively to the previous question pointed out that the remote teaching model accelerated the adoption of GAI in higher education**.** This is why it became the first category of analysis. Based on this, we highlight:

I believe the pandemic accelerated the adoption of new technologies in all areas, including higher education. Generative AI is a consequence of the digital transformation that companies, educational institutions, public initiatives, and society are undergoing (E04).

The need for technological support has driven the use of virtual assistants and chatbots, and the expansion of hybrid teaching has favored the personalization of learning and the automation of academic tasks.

Many technological processes in education that would have taken longer have been accelerated by the pandemic. Using resources such as new applications for remote learning has been essential during the pandemic (E07).

The complexity of the phenomenon is evident to the interviewees, who highlight the challenges that GAI has introduced to higher education, particularly about assessing academic work authorship. Costa et al. (2025) examined the advantages and disadvantages of using AI in a university setting from the viewpoint of postgraduate teachers. They found that the main challenges raised by the interviewees were the risk of plagiarism, dependence on AI tools, a lack of critical reflection, and difficulties with infrastructure and financing.

Ethical issues related to the use of GAI in education are a topic of discussion at the global level. In 2022, the United Nations Educational, Scientific and Cultural Organization (UNESCO) published the Recommendation on the Ethics of Artificial Intelligence to guide member states in formulating national policies and strategies that promote the ethical use of AI. This recommendation focuses on several areas, including education. The 2022 UNESCO recommendation stipulates that systems used for student learning must meet rigorous monitoring, skills assessment, and prediction of student behavior requirements.

It is worth noting that aspects related to assessment were already a concern for teachers in remote education during the pandemic. At that time, one interviewee discussed the need to rethink pedagogical practices due to concerns about the qualitative aspects of the assessment process. The pandemic experience showed that technological tools enable assessment innovation but also highlight the need to adopt mechanisms that ensure learning quality and student authorship. Faustino, Constantino, and Gonçalves (2025) emphasize that "AI can be used to generate fake content, such as research papers or exam responses, which poses risks to ethics and academic integrity."

Remote learning served as a kind of "gateway" for the adoption of generative AI in higher education because it created an environment conducive to technological innovation, expanded the digital literacy of the academic community, and highlighted the need for more

flexible and intelligent tools in the teaching-learning process.

Teachers in this category reported that their teaching practices during the pandemic allowed them to discover ways to personalize learning, facilitate student interaction, automate tasks, and correct academic work (E02, E04, and E08). Respondent E06 stated that teachers became more open to new methodologies. This was complemented by E08's perception that the academic environment became more receptive to new technologies.

However, we note that teacher openness to new digital tools is insufficient for successful teaching and learning processes. Costa et al. (2025) emphasize that implementing AI in education must be organized and procedural, with an emphasis on teaching support. This approach distances itself from the idea of teaching-learning processes being automated like robots. According to the authors, this is achieved by training professionals in this field to advance the technical skills necessary to interact with and take advantage of AI's offerings. This statement aligns with Volpato's (2010) and Wiebusch and Lima's (2018) understanding of the need to overcome organizational and pedagogical planning and management challenges so innovation can effectively become part of teaching and learning processes.

After analyzing reports from teachers who said, that remote teaching during the pandemic did not influence the adoption of GAI tools in higher education, two categories emerged. The first category consists **of teachers' lack of understanding of GAI tools.** The second category is **related to the idea that GAI adoption in higher education would occur regardless of the pandemic.**

In the first category, we found that teachers are still in the process of understanding the use of GAI tools in higher education, as discussed by respondent E08.

It has not influenced my teaching practice, as AI tools had not yet become widespread in Brazil during the pandemic. I am currently still in the process of understanding generative AI tools for use in higher education and other areas. I only began exploring these tools last year, in 2024.

In fact, GAI technologies had not yet spread throughout the academic environment at the onset of the pandemic. Non-generative artificial intelligence, however, was already part of the systems used in virtual academic environments and served as an indispensable resource for maintaining educational services during the period of social isolation.

Now that the health emergency is over, we must reflect on the possibilities and limits of using these resources, whether generative or not. Nóvoa and Alvim (2021, p. 12) point out that the pandemic forced us to respond immediately and urgently, leaving no time for preparation or reflection. The authors further argue that this cannot be the future and urge the educational field to engage in a debate committed to comprehensive individual education. Thus, this discussion must be incorporated into the development plans of higher education institutions (HEIs), permeating their institutional policies and the pedagogical projects of their courses.

Bottentuit Junior et al. (2024) state that while GAI can transform students' reality, it also presents challenges for teachers and educational managers who must stay informed about the latest trends and integrate them into their teaching practices. Similarly, Costa et al.'s (2025, p. 15) research corroborates the findings in this category of analysis. Their interviewees also highlighted "the need for training and development of technical skills for the integration of AI in education." Considering this phenomenon, UNESCO (2022, p. 34) stated that:

> *Member States should encourage research initiatives on the ethical and responsible use of AI technologies in education, teacher training, and e-learning, among other issues, to increase opportunities and mitigate the challenges and risks involved in this area. Initiatives should be accompanied by adequate assessment of the quality of education and the impact of the use of AI technologies on students and teachers.*

The results of the research by Faustino,

Constantino, and Gonçalves (2025) also highlight a relevant aspect. The authors point out that "excessive dependence on technology represents a real danger, potentially excluding those who do not have equal access to devices and high-speed connectivity." The authors also express concern about the potential replacement of teachers by AI systems and emphasize that AI should be viewed as a supplementary tool to enhance teaching and automate administrative tasks. Costa et al. (2025) also address this perspective, stating that GAI in education is not restricted to teaching or learning activities but also plays a fundamental role in university management. AI can optimize resources and time in educational administrative processes. In a second category of analysis, we find respondent E11's discourse, who believes that the adoption of GAI in higher education would have occurred regardless of the pandemic and is only linked to the launch of this technological resource on the market. For him:

No. In my opinion, the adoption of generative artificial intelligence in education would have occurred regardless of the pandemic in a scenario where the launch of such technology had taken place even without the pandemic. Such technology provides tools that, when used properly, aid in the development of teaching materials, study, and writing. Thus, regardless of the pandemic, it would help both teachers and students in any scenario (E11).

In fact, it seems to us that the adoption of GAI in education is inevitable. However, the data revealed that most respondents associate the pandemic with accelerating the adoption of GAI in higher education. The openness of teachers and students to new technologies has driven the adoption of GAI resources, which the research subjects predominantly view as tools that facilitate the teaching and learning process.

In short, despite the technological openness established by the pandemic in the educational sphere, the use of GAI still requires critical and ongoing discussion in academic environments and educational regulatory bodies in Brazil. This discussion is necessary to develop clear guidelines for using this new resource in teaching and learning processes. These guidelines should prioritize the integral development of all students and avoid precarious teaching work.

5 FINAL CONSIDERATIONS

The research demonstrated that innovation in higher education for teachers involves redefining teaching methodologies and practices, ensuring student participation in the learning process, connecting theory and practice, and utilizing technological resources.

All interviewees stated that pandemic-era innovation was related to technology-mediated classes, but they also highlighted other significant possibilities for innovation that emerged during that period, such as scientific meetings with remote participation of academic authorities and renewed assessment processes through digital technology.

Most research participants said that the remote teaching model accelerated the adoption of GAI in higher education, which makes sense given that the pandemic expanded teachers' perceptions of the possibility of using flexible, intelligent tools in teaching and learning. Regarding teachers who do not believe that the pandemic contributed to the diffusion of GAI in higher education, a perception stood out: that GAI adoption would occur regardless of the pandemic period with the launch of this technological resource.

Additionally, the research contributed to the systematization of important issues permeating the use of GAI in higher education. These issues include the need to establish clear guidelines for using these technologies, emphasizing monitoring, assessing skills, and predicting student behavior. This recommendation aligns with UNESCO's (2022) advice to avoid unethical conduct, such as creating false and unauthorized content.

It is also necessary to overcome challenges related to university planning for the organized and regulated incorporation of GAI into teaching and learning processes, prioritizing teacher training and the creation of objective conditions for teachers to integrate GAI into their

teaching practices, with a view to personalizing learning, facilitating interactivity with and among students, and automating bureaucratic tasks.

The use of this new digital tool, however, deserves deep and prior reflection on the risks related to digital exclusion and increased inequality in education, the precariousness of teaching work, and the distancing from comprehensive student training, which we believe is only possible through human interaction, in a continuous process of teacher mediation and student interrelation.

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