Chapter # 1

GENERATIVE AI IN HIGHER EDUCATION: IMPACTS ON TEACHING AND LEARNING

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ABSTRACT
The rapid advancement of artificial intelligence (AI) technologies, particularly generative AI and Natural Language Processing (NLP) tools is transforming higher education. This study investigates the integration of AI in tertiary educational settings, focusing on its impact on teaching practices and learning outcomes. Our corpus analysis highlights the prominence of AI in education, with frequent references to AI applications such as ChatGPT and large language models. These technologies offer innovative solutions for personalized learning, intelligent tutoring systems, and enhanced pedagogical methods. The analysis reveals a significant focus on practical implementations of AI, emphasizing the transformation of traditional teaching methodologies. The study also addresses critical issues such as the technological infrastructure required for AI integration and the ethical considerations of AI use in education. The findings suggest that while AI holds promise for revolutionizing education, there is a need for a balanced approach that includes developing critical thinking skills and addressing ethical implications. This research contributes to the growing body of literature on AI in education by providing a detailed exploration of current trends, challenges, and future directions in the field.

Keywords: generative AI, natural language processing (NLP), higher education, innovative pedagogy.

1. INTRODUCTION

The relationship between human intelligence and artificial intelligence (AI) has become a central topic over time and in various fields of knowledge, including philosophy, cognitive science, and technology. While both aim to address complex problems and adapt to new situations, they differ significantly in their origins, mechanisms, and capabilities. Human intelligence evolves through biological processes, social interaction, and lived experience, and encompasses consciousness, emotions, creativity, and tacit knowledge. In contrast, AI is a system designed by humans to replicate or surpass specific cognitive tasks. It exhibits advanced skills in managing data and discerning patterns but lacks self-awareness, emotional depth, and holistic reasoning. (Korteling et al. 2021).

Artificial Intelligence (AI) has emerged as an overarching change force in all levels of learning, transforming pedagogical practice from pre-school classes to vocational training centers and college classrooms. While early implementation of AI was predominantly restricted to the tertiary education sphere, generative applications like ChatGPT (OpenAI, 2023) currently permeate different learning spaces, including schools and colleges in K-12 (Kindergarten to 12th grade), corporate training modules, and non-formal lifelong learning settings. Bahroun et al. (2023), situate this democratization of technology in the context of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), analyzing 207 studies to identify such major gaps in fields such as medical and engineering education,

where intelligent tutoring systems and adaptive learning driven by generative AI (GAI) are transforming pedagogical standards.

The AI is transforming the educational field in terms of improving pedagogical practices, raising students' engagement, and reducing administrative workload (Villamil, et al. 2024). Generative AI, such as Natural Language Processing (NLP) tools like ChatGPT, has been demonstrated to be largely promising in facilitating personalized learning experiences, intelligent tutoring systems, and tailored evaluation (Quezada and Urbina, 2025) and (Gavira-Duron, 2023). These technologies underpin learning theories like constructivism, connectivism, and adaptive learning, promoting student-centered, adaptive, and data-driven learning (Pineda et al. 2024). However, the use of AI in education also has ethical effects on equity, digital literacy, and institutional readiness (Gómez, Fuentes and Castro, 2024). This model discusses how generative AI reconfigures teaching methods and learning processes and resolves these significant concerns.

Building on these foundations, Katonane (2024) extends this ground by illustrating how AI adaptive learning systems improve learning outcomes and at the same time raise ethical issues regarding their scalability, particularly in resource-scarce environments, the voracious expansion of large language models (LLMs) has hastened such shifts. Teachers at all levels have grappled with its meaning since ChatGPT came into public view in November 2022. Saariluoma and Karvonen (2024) investigate the languages of AI construction at the back of which rests underlying theory restrictions in educational technology construction. Formal, computational, and natural language are distinguished as formal languages (mathematics and logic) not having semantics relevant to the world, computational languages having domain-limited references, and natural language with dynamic creative expression. These distinctions clarify the perennial debate between strong AI (human-like cognition) and weak AI (task-specific solutions), revealing how design choices in theory languages shape AI's pedagogical potential and limitations.

From high school teachers redesigning writing assignments to medical schools incorporating AI diagnostics simulations (Lund and Wang 2023). López-Chila et al. (2024) quantify this trend through bibliometric analysis of 870 articles, which indicate the prevalence of computer science and education journals for AI research. Their focus on higher education nevertheless points to a significant omission: only 12% of the publications reviewed focused on primary or vocational contexts despite growing evidence of AI adoption in these sectors. Papadogiannis, Wallace and Karountzou (2024) justify these facts on the basis of educational data mining (EDM), demonstrating that algorithms such as classification, natural language processing (NLP), and regression analysis enable customized learning experience on a global level but with concern about algorithmic bias in the case of non-rigorous ethical frameworks.

Democratization of AI technologies carries special meanings in developing countries where technological leapfrogging crosses over with limited resources. These programs are compatible with Bahroun et al. (2023) calls for multidisciplinary directions in considering explainable GAI models capable of mitigating cultural bias. The issue should be addressed in educator preparation Adekunle et al. (2024) point to the importance of AI literacy for pre-service teachers, who will turn out to be constructors of learning institutions.

This study challenges such multifaceted changes in terms of through cross-contextual analysis. By synthesizing evidence from peer-reviewed studies, industry case studies, and policy documents, we aim to map concrete AI deployments across education levels (K-12, vocational, higher), analyze competing pedagogical and ethical concerns by institutional context, and propose equity-focused frameworks for responsible AI deployment.

2. BACKGROUND

Constructivist theories, explained by Jean Piaget (1969) and Lev Vygotsky (1926), focus on the construction of knowledge through active learning and social interaction. Recent studies show that AI technologies support these theories by personalizing learning experiences. For example, AI adaptive learning systems in early childhood improve understanding and recall by modifying content to fit individual needs (Veces et al. 2024). Interactive content, like AI-backed simulations, allows students to discover and actively participate in constructing knowledge (Quezada and Urbina, 2025). In addition, AI-generated content supports independent learning, where students connect information based on their own comprehension (Peralta, Patraca and Martínez, 2024).

Contemporary analysis underscores the relevance of exploring the integration between the constructivist paradigm and developments in artificial intelligence, highlighting the potential of this combination to generate new theoretical and methodological perspectives and enhance the results of the cognitive process. Some examples will be presented below.

Mota-Valtierra, Rodríguez-Reséndiz, and Herrera-Ruiz (2019) applied constructivism methodologies in a course where the students have to develop their practical knowledge about artificial intelligence techniques and theoretical mathematics. The model was used in biomedical engineering and mechatronic engineering primarily and the final evaluations corroborate the increase in the knowledge of the students.

In a similar field of knowledge, Minalla and Fawad (2025) examine the integration and impact of AI tools, specifically ChatGPT and MATLAB Simulink, within undergraduate chemical engineering courses, the investigation concludes that the incorporation of AI contributes to personalized learning, improved academic performance, and increase student engagement, also, help students to independently explore and understand abstract concepts through simulations.

In the area of cybersecurity, Salman (2024) highlights that the incorporation of artificial intelligence stimulates in students the capacity to address real-world challenges, while simultaneously promoting greater engagement, improved technical performance, and stronger preparation for roles shaped by AI-driven practices.

Richter, Giroux, Piven, Sima, and Dodd (2025) present a case study on an undergraduate digital marketing course that integrates ChatGPT with other generative AI tools for text-to-image and text-to-video generation while simultaneously incorporating traditional digital marketing platforms such as HubSpot and SEMrush. As part of the study, representatives from the business sector were consulted regarding the usefulness of artificial intelligence in the development of student practices. Their feedback pointed out a positive impact, noting that AI facilitated the connection between students and relevant practical cases.

The application of artificial intelligence has also demonstrated notable advancements at the K–12 level, as evidenced in the research conducted by Kunnath and Botes (2025). The authors investigated the potential of using AI educational applications to promote Inquiry Based Learning (IBL) and critical thinking in the science classroom. Grounded in social constructivist theory, the paper highlights that AI tools can be useful in automated data collection, enabling virtual labs, and assisting in the evaluation of scientific data. Also, AI-powered educational platforms like Magic School, Edpuzzle, Labster, and LabXchange allow learners to conduct virtual experiments without the need for physical equipment. The combination of these platforms offers promising solutions by automatically creating interactive lessons that encourage scientific inquiry, critical thinking, and the practical

application of concepts. The investigation focuses on 7th and 9th level in South Africa classrooms.

Yim and Su (2025) analyzed 46 studies in academic conferences and journals to investigate the pedagogical strategies and learning tools in AI literacy education in K-12 contexts. In their study, they classify the most appropriate methodologies for AI literacy according to each educational level. Their findings indicate that for levels like kindergarten, the use of tools like Pop-Bots is important in combination with project-based approaches, human-computer interactions and play-based learning strategies to teach young students AI concepts. The project-based learning approach is also the most dominant in secondary schools, followed by collaborative learning. This review reveals that constructivism and computational thinking serve as key frameworks for addressing AI literacy education.

The impact of artificial intelligence is also significant when examined through the lens of other educational theories, like Vygotsky's sociocultural theory (1926) which is also supported by AI, which aids in learning. AI systems allow for the easier delivery of personalized content and improving student-teacher interaction to fill gaps in understanding (Arango et al., 2024). AI offers guided models within the Zone of Proximal Development (ZPD) and improves how students interact with technology, improving collaborative learning (Benavides et al. 2024). Digital constructivism emphasizes the capability of teachers and students to be technologically competent. Such competency is essential for AI to effectively facilitate autonomous learning (Villamil et al. 2024).

AI fits well with Adaptive Learning Theory and Gardner's Multiple Intelligences, showing that it can cater to different learning styles. By modifying lessons based on students' performance, AI renders the learning process individualized (Prince Torres, 2022), these systems recognize strengths and weaknesses in different intelligences, like language, spatial capacity, and math personalizing activities to stimulate students. For example, adaptive platforms convert difficulties to fit all learners, enhancing inclusivity and academic success (Veces et al., 2024). This not only boosts motivation but also guarantees equal access to education for all people, catering to different learning styles and needs.

Siemens (2005) connectivism argues that knowledge develops through networked interactions, which is a model fostered by AI. AI is supported by technologies such as dynamic content generators and collaborative platforms that enable peer-to-peer co-construction of knowledge, unlike static curricula, AI continuously analyzes students' progress, enabling real-time content adjustment and personalized feedback (Flores and Nuñez, 2024). Learning analytics allows educators to detect gaps using data, whereas computerized exams enhance self-regulation and computer literacy readiness (Gómez, Fuentes and Castro, 2024).

AI enhances teaching by stimulating students to inquire and discover. Interactive simulations and virtual tutors enable students to learn through real-world issues (Villamil et al., 2024). In flipped classrooms, AI personalizes the content that students learn prior to class, enabling them to devote more class time to critical thinking and collaboration (Montenegro-Rueda and Fernández-Cerero, 2022). Educators move from simply presenting information to facilitating student learning, utilizing AI to assist and promote in-depth comprehension (Villamil et al., 2024).

AI applications bring up essential ethical issues. We need to reduce algorithms' bias and data privacy (Gómez, Fuentes and Castro, 2024). Students need to study AI so that they can critically evaluate AI-generated materials (Peralta, Patraca and Martínez 2024). We need to focus on equity and inclusiveness so that no one is excluded. Training teachers on the ethics of AI will facilitate the responsible usage of AI (Gómez, Fuentes and Castro, 2024). These steps are crucial towards fostering positive behavior online in AI-based education.

3. METHODS

This study employs a mixed-methods design to analyze generative AI's role in education, combining natural language processing (NLP) of academic literature with qualitative case studies. This approach ensures methodological triangulation, balancing broad thematic trends with granular insights into real-world applications. A purposive sample of 52 peer-reviewed articles (2024) was extracted from Emerald Publishing Limited, focusing on AI in education. This sample aligns with NLP research conventions, where corpora of 50–60 articles suffice to identify disciplinary discourse patterns (Xu and Ouyang 2022); (Mousavinasab et al. 2018). Articles were filtered using keywords (generative AI, pedagogical innovation, educational transformation), supplemented by industry case studies and policy documents to contextualize findings.

The text preprocessing begins with the cleaning and tokenization of the data, non-alphabetic characters and words that do not provide results were eliminated (for example, "the", "and") and the texts were reduced to lowercase. Tokenization was then carried out with which texts were segmented into word-level units following white space boundaries (Webster and Kit, 1992), structuring data for computational analysis. After cleaning the data, lemmatization was performed, using NLTK's WordNetLemmatizer (Bird, Klein and Loper 2009), the inflected words (e.g., "learn" → "learn") were assigned to their canonical form (Plisson, Lavrac and Mladenić 2004). This ensured terminological coherence, which is essential for analyzing conceptual constructions in academic texts (Korenius et al., 2004); (Sproat et al. 2001).

To then carry out the quantitative analysis in two parts:

1. *N-Gram Models:* Markov chain-based n-gram analysis identified recurring phrases (e.g., "adaptive learning systems," "ethical implications"), revealing dominant pedagogical and technological trends.
2. *Topic Modeling:* Latent Dirichlet Allocation (LDA) algorithms clustered the 316,687-word corpus into themes (e.g., AI ethics, personalized learning), highlighting scholarly priorities.

4. RESULTS ANALYSIS

The n-gram analysis revealed key clusters shaping the current discourse on AI in education, aligning with the study's focus on pedagogical transformation and institutional adoption. Below, we synthesize the findings at the n-gram levels, emphasizing their theoretical and practical implications. The number of occurrences of each word or words in the n-grams is shown in Table 1.

Table 1.
N-gram results.

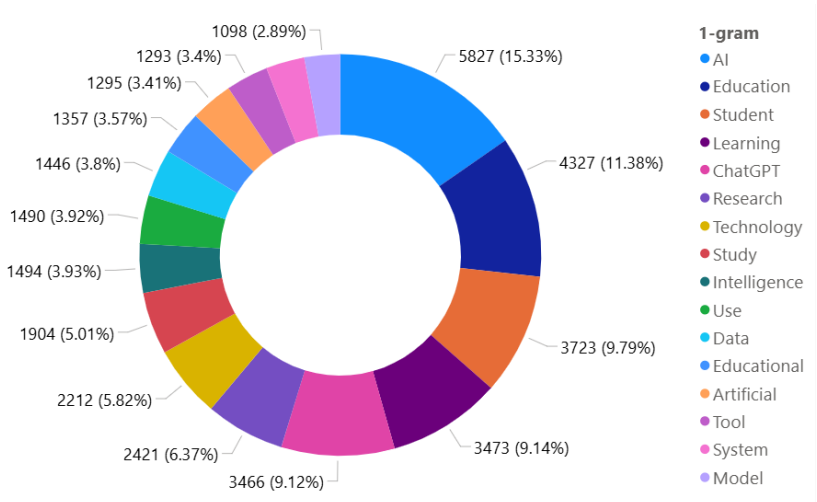
Place	1-gram word analysis	2-gram word analysis	3-gram word analysis
1	AI (5827)	Artificial intelligence (1193)	Artificial intelligence AI (165)
2	Education (4327)	Higher education (824)	Artificial intelligence education (146)
3	Student (3723)	Generative AI (444)	AI higher education (106)
4	Learning (3473)	AI tool (340)	Natural language processing (88)
5	ChatGPT (3466)	AI education (319)	Large language model (84)

Place	1-gram word analysis	2-gram word analysis	3-gram word analysis
6	Research (2421)	AI technology (270)	Generative artificial intelligence (84)
7	Technology (2212)	Use ChatGPT (257)	Higher education institution (63)
8	Study (1904)	Use AI (247)	Generative AI tool (61)
9	Intelligence (1494)	Teaching learning (226)	Education information technology (60)
10	Use (1490)	Machine learning (215)	Research innovative teaching (55)
11	Data (1446)	Learning experience (208)	ChatGPT Management education (53)
12	Educational (1357)	Management education (203)	Systematic literature review (51)
13	Artificial (1295)	Critical thinking (199)	Intelligent tutoring system (51)
14	Tool ((1293)	Language model (189)	Innovative teaching learning (48)
15	System (1184)	AI literacy (187)	System science education (47)
16	Model (1098)	Using ChatGPT (184)	Perceived ease use (45)

Note: Own elaboration.

In the 1-gram analysis, the corpus prioritized AI (5,827 occurrences) and education (4,327), reflecting the field's central focus on technological integration. The high frequencies of student (3,723) and learning (3,473) underscored a student-centered orientation, consistent with the constructivist principles highlighted in the literature review (Veces et al. 2024). In particular, ChatGPT (3466) emerged as the most cited tool, pointing to its disruptive impact on pedagogical practices. The prominence of research (2,421) and technology (2,212) reinforced the dual emphasis on empirical research and applied innovation, reflecting the mixed methods design of this study. Figure 1 shows the analysis of the 16 most common 1-gram words.

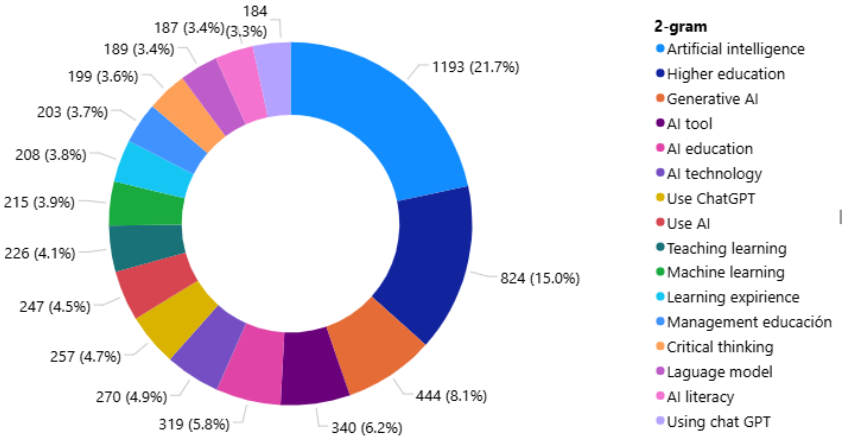
Figure 1.
Analysis of the 16 most common 1-gram words.



Note: Own elaboration.

The analysis of 2-grams emphasizes AI's central role in the corpus. Its high frequency (1193 occurrences) indicates that it is a fundamental concept around which much of the research revolves, aligning with the growing integration of AI technologies in educational settings and the increasing academic interest in this intersection. Showing the contextualization of AI applications, higher education predominated (824), suggesting an emphasis on university student research compared to K-12 or vocational contexts, a gap observed in the literature review (López-Chila et al., 2024). On the other hand, there is a rise in generative AI (444) and AI tools (340) highlighted the rapid adoption of technologies such as ChatGPT, aligning with studies on personalized learning (Quezada Vera and Urbina Velasco, 2025). Figure 2 shows the analysis of the 16 most common 2-gram words.

Figure 2.
Analysis of the 16 most common 2-gram words.



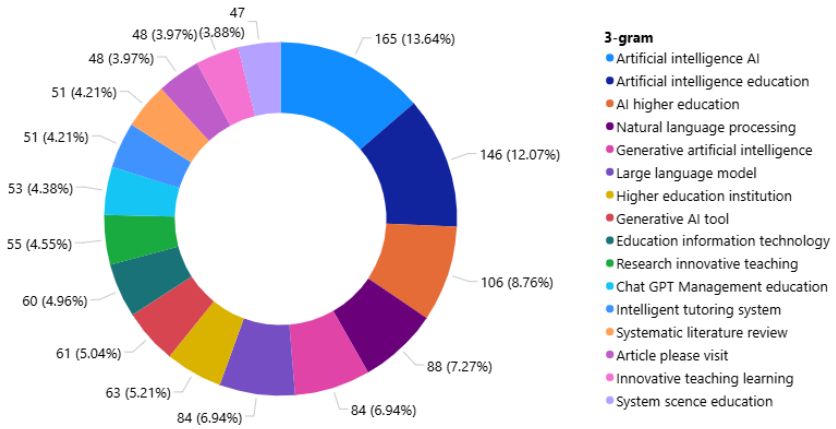
Note: Own elaboration.

Regarding practical implementation, phrases such as use ChatGPT (257) and AI technology (270) dominated the theoretical terms, emphasizing a pragmatic shift towards tool implementation. Regarding dual pedagogical objectives, AI education (319) and teaching-learning (226) revealed parallel interests in both teaching about AI and improving pedagogy with AI, echoing the literature's emphasis on AI literacy (Gómez, Fuentes and Castro, 2024).

Kathala and Palakurthi (2024) state that AI literacy has become a vital skill, comparable to reading, writing, and arithmetic in education and workforce development, and it is a core competency for employability and career progression. The authors define AI literacy as a combination of technical expertise, ethical reflection, and practical competencies. Its main elements generally include: familiarity with fundamental AI concepts and methods; the capacity to critically assess AI systems and their broader implications; ethical sensitivity and the ability to reason about AI's societal consequences; and learning through practical, real-world projects to effectively use and engage with AI tools. Unfortunately, while awareness of AI's relevance is increasing, many countries still lack the infrastructure and resources to implement widespread AI education. Other persistent challenges that AI literacy faces are: limited technological infrastructure, a shortage of qualified educators, curriculum gaps, language and cultural barriers, and insufficient policy support.

The 3-gram analysis shows us the emerging frontiers, AI higher education (106) and higher education institutions (63) reaffirmed the tertiary bias of the field, while educational information technology (60) highlighted critical infrastructural concerns for scaling AI (Papadogiannis, Wallace and Karountzou, 2024) Regarding technical and pedagogical innovation, natural language processing (88) and generative artificial intelligence (84) highlighted cutting-edge methodologies, while research in innovative teaching (55) linked AI with pedagogical experimentation, in resonance with connectivist frameworks (Siemens, 2005). Figure 3 shows the analysis of the 16 most common 3-gram words.

Figure 3.
Analysis of the 16 most common 3-gram words.



Note: Own elaboration.

The concept of Critical thinking which appears in the 2-gram with a frequency of 199 repetitions, highlights the interest in the role that artificial intelligence can play in the development of the cognitive skills required in the 21st century, commonly known as the 4Cs, which consist of: critical thinking, creativity, communication, and collaboration. In the context of the development of these cognitive skills, the impact of AI on educational environments has emerged as a central topic of study, generating significant debate due to the notable divergences regarding its possible positive and negative effects. When it comes to the development of critical thinking, we find opposing positions. For example, while some studies, such as Cantero et al. (2020), argue that AI has not yet reached full maturity and that there is insufficient empirical evidence linking its use to the development of this skill, other works, such as Parreño Sánchez et al. (2024), suggest a more optimistic outlook. Parreño's and colleagues findings suggest that incorporating AI as a teaching tool can enrich teaching strategies and methodologies aimed at fostering critical thinking. This process is enhanced by improved access to information, automated repetitive tasks, developed analytical skills, stimulated debate and discussion, and promoted problem-solving skills. The interaction between human experience and AI use already plays an important role in current lines of research. Understanding how this interaction could enhance key competencies in modern education is essential to progressing toward education that aligns with the sustainable development goals defined in the 2030 Agenda.

The results: management education (203) and intelligent tutoring system (51) reflect the growing trend of using AI as a facilitator in the autonomous learning process, as well as self-management and self-assessment of the cognitive process. Recent research, such as that by Clegg and Sarkar (2024), highlights that artificial intelligence can play a crucial role in supporting students' understanding of complex topics, acting as a personalized tutor that adapts to each student's pace, language, and learning style. Intelligent tutoring has significant advantages, such as personalized learning that adapts to each user's pace and difficulty level, as well as the ability to provide immediate feedback. However, there are also significant challenges, such as the cost of accessing these types of tools, the technical and human resources required for their development, the empathy with the student in the feedback process, and the creation of a possible dependency in the user.

The terms innovative teaching learning (48) and research innovative teaching (55) are linked to the interest in leveraging the advantages that artificial intelligence offers to transform and optimize learning experiences. This trend seeks not only to improve educational effectiveness but also to innovate in pedagogical methodologies, integrating advanced technologies that promote a better and more efficient learning process. In this regard, recent research, such as Clegg and Sarkar (2024), highlights that the automation of routine tasks allows for the optimization of time and effort, which, in turn, accelerates and enriches the cognitive process, favoring research and innovation.

The expression AI literacy (87) refers to the degree of knowledge, skill, or competence that a user may have in relation to the use of artificial intelligence. This term, with complex connotations, can vary depending on the context, as it should also focus on a person's ability to understand, use, and critically reflect on the results obtained through interaction with AI. Likewise, concerns arise in the field of research regarding cognitive biases associated with factors such as gender, area of knowledge, educational level, and profession. In this regard, Duan et al. (2025) shows notable differences in terms of skill and acceptance levels between disciplines, between men and women, and between undergraduate and graduate levels. Their results indicate greater adoption and adaptation of AI in STEAM areas, greater optimism toward its use by men compared to women, as well as a perception of greater knowledge of AI among men compared to women, and a positive correlation between the use of AI and the level of education attained.

Finally, the terms using Chat GPT (184), Chat GPT management education (53), and perceived ease of use (45) reinforce the enormous popularity that this language tool currently enjoys. Among the features that have driven this phenomenon of acceptance are: free access to basic functionalities, the possibility of interacting with the platform without prior knowledge, its intuitive use, and the tool's ability to personalize interactions and learn from each one. These features have positioned ChatGPT as a highly valued tool, not only for students but also for professionals in various fields, establishing it as a benchmark in the integration of AI in educational and work environments.

A key finding of this study is that current research tends to overlook the ethical challenges associated with the use of artificial intelligence in education. Instead, it places greater emphasis on potential applications, paying less attention to possible risks. This imbalance reveals a significant gap that could lead to considerable social and economic consequences.

In this regard, studies like Gallent-Torres, Zapata-González, and Ortego-Hernando (2023) identify risks such as plagiarism, the production of unoriginal content, excessive dependence on these technologies—which can weaken critical thinking and hinder the detection of misinformation—and the presence of bias in the results. For their part, Cárdenas, Penna, and Rascón (2024) emphasize ethical and moral challenges related to transparency

and accountability, the responsibility of software development companies, regulation and governance, cybersecurity, and technological unemployment as critical dimensions.

In a more specific context, Kunnath, and Botes (2025) show how infrastructure limitations in South African schools, especially in rural areas, can deepen the digital gap and increase educational inequalities. They also highlight the importance of contextualizing AI-generated content, given that the examples offered by these technologies may not reflect students' cultural experiences, affecting their engagement and reducing the value of practical cases.

In this scenario it is essential to recognize that the use of generative AI in education poses significant challenges to academic integrity and social equity. Therefore, it is necessary to delve deeper into the debate on the academic use of AI to ensure responsible practices in its application. Consequently, a deeper debate on the academic application of AI is required to ensure responsible practices. In addition, there is an urgent need to establish regulatory frameworks that safeguard data protection, security, algorithmic fairness, and accountability in automated decision-making.

The analysis confirms the transformative role of AI in higher education, particularly through generative tools like ChatGPT, but reveals three critical points:

1. Equity gaps: The tertiary focus of the corpus contrasts with the emphasis on the democratizing potential of AI, suggesting underexplored opportunities in K-12 and vocational training.
2. Theory-practice balance: The predominance of applied terms (use ChatGPT) over pedagogical theories (e.g. constructivism) suggests a risk of tool-centric discourse, requiring a stronger theoretical foundation.
3. Lack of an ethical component: In the development of n-grams, it is observed that the ethical component in AI research in education does not appear among the 20 most frequent n-grams. This indicates the need for deeper ethical scrutiny, as noted by Gómez, Fuentes, and Castro (2024).

These findings validate the literature's emphasis on adaptive learning and student-centered design, but challenge assumptions about the equitable reach of AI across educational levels.

5. FUTURE RESEARCH DIRECTIONS

The results obtained in this research reveal that current lines of study focus mainly on the adoption and use of artificial intelligence (AI) in higher education. At these academic levels, the application of artificial intelligence is closely related to complex cognitive objectives ranging from self-management and self-assessment of knowledge to the development of key cognitive skills such as critical thinking and innovation.

In the near future, it will be a priority to expand research on the possible pedagogical uses and potential effects in the field of K-12 education, as these may differ significantly from the results obtained here. While AI offers transformative opportunities at all educational levels, the degree of development and maturity, as well as differences in student competence levels, require rigorous research to guide the use of AI in a consistent manner with educational objectives and the comprehensive development of students at each of their respective cognitive stages.

The methodology used in this study could also be a valuable exercise for analyzing the evolution of research lines related to AI and education by observing their evolution over time, allowing for the identification of emerging trends by period, region, or country.

This approach would not only facilitate the detection of patterns of change but also offer a more complete view of the global research landscape in this area.

6. CONCLUSION

Generative AI is redefining educational paradigms by putting constructivist, adaptive and connectivist theories into practice, enabling personalized learning experiences and institutional innovation, particularly in higher education, as demonstrated by the predominance in the corpus of terms such as higher education. The analysis shows a significant relationship between constructivist learning theory and the potential of artificial intelligence to enhance autonomous learning. This is evident in the creation of interactive lessons, the study of practical cases, and the possibility of conducting simulations in laboratory environments, which contributes to the understanding of abstract concepts.

However, the findings also underscore three critical issues that require attention. First, there is a bias in the study of AI applied in university contexts as opposed to K-12 levels, which points to untapped potential in basic education or technical and vocational training, where AI could significantly contribute to reducing inequalities and expanding access to knowledge.

Secondly, there is insufficient treatment of ethical issues. We can observe that this aspect does not appear significantly in the corpus of texts analyzed which shows limited attention to issues such as transparency in information management, algorithmic fairness, academic integrity, excessive dependence on new technologies and resilience to their adoption, as well as low literacy in AI management. Added to this are inequality in access to technological advances, the potential educational gaps that may arise, technological unemployment, and other ethical and social challenges. For this reason, as Gómez, Fuentes, and Castro (2024) point out, it is essential to deepen ethical scrutiny in order to anticipate risks and establish regulatory frameworks to accompany technological development.

Finally, an imbalance between theory and practice is identified, given that applied terms—such as the use of ChatGPT—predominate over references to pedagogical theories, for example, constructivism. This emphasis on the tool over theoretical foundations can lead to a discourse focused on technology rather than learning processes, underscoring the need to strengthen the conceptual frameworks that guide its implementation.

Taken together, these three points reveal that, while AI represents a significant advance for higher education, its full impact will depend on the ability of research and educational practice to address inequalities, deepen ethical reflection, and balance the use of tools with a solid theoretical foundation. Only then will it be possible to harness its transformative potential without compromising the fundamental values of education.

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